

Chapter 3 Water Quality Monitoring

Introduction

Water quality monitoring in 2003 continued according to the amended protocol implemented by the Department of Water Resources (DWR) in 1996. As described in the 1996 Water Quality Report (DWR 2001), discrete water quality samples were taken monthly at each of 11 representative sites (Figure 3-1). Data were recorded within one hour of high slack tide and the time of each sample was recorded to the nearest five minutes of Pacific Standard Time. A qualitative statement of weather conditions (i.e., wind conditions and cloud cover) was recorded for each cruise. Samples were analyzed for 15 physical and chemical parameters shown in Table 3-1. The complete database is available online at <http://baydelta.water.ca.gov>.

As shown in Table 3-2, eleven sampling sites were used in this study to represent eight regions of the Bay-Delta system. Water quality conditions in each of six regions were represented by a single sampling site. The south Delta and Suisun Bay, however, were represented by two and three stations respectively.¹ In previous reports, data from multiple sample sites within each region have been averaged according to the “hierarchical cluster analysis protocol”; however, for clarity, data results in this report are shown for each sample site.

Parameters Measured

Except as noted, all discrete water quality samples were obtained with shipboard sampling equipment using the DWR research vessel *San Carlos*. Supplemental discrete samples were taken with mobile laboratory equipment at sites in the south Delta (C10 and C3) which are inaccessible to the vessel *San Carlos*. Secchi disk depth is not taken at site C10 due to restrictions of the sample site, which requires sampling equipment to be deployed from a bridge.

Water Temperature

Water temperature was measured in degrees Centigrade (°C) with a YSI thermistor. For all sites except the south Delta, temperatures were measured from water collected at a depth of one meter. In the south Delta, temperatures were measured by submerging the YSI thermistor to a one meter depth.

A water temperature minimum of 9.1 °C was recorded in November 2003 at station C10, in the south Delta (Figures 3-2 and 3-3). This minimum temperature represents an increase of 1 °C over the previously recorded minimum for the 2001-2002 period, and a 2 °C increase over the minimum reported for the 1997-2000 period (DWR 2003 and 2004).

¹ An exception to this protocol exists for Secchi disk depth measurements for the south Delta region. Secchi disk depth measurements for this region are represented by a single sampling at Site P8, as no Secchi disk depth measurements are made at sampling Site C10.

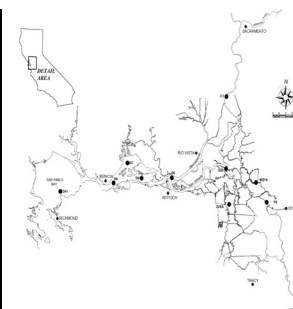


Figure 3-1 Water quality monitoring stations

Parameter	Units
Water temperature	°C
Dissolved oxygen	mg/L
Secchi disk depth	cm
Turbidity	NTU
Dissolved silicate	mg/L
Total phosphorus	mg/L
Dissolved oxygen	mg/L
Dissolved organic nitrogen	mg/L
Dissolved organic carbon	mg/L
Total dissolved solids	mg/L
Total suspended solids	mg/L
Total suspended solids	mg/L
Salinity	psu
Chlorophyll	mg/L

Table 3-1 Water quality parameters measured

Region	Sampling Site
Lower Sacramento River	C4
Lower San Joaquin River	C2
North Delta	C3
Central Delta	C5
East Delta	C6
South Delta	C10 and C3

Table 3-2 Water quality sampling sites and regions

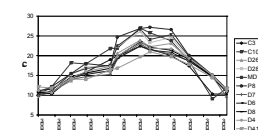


Figure 3-2 Water temperature

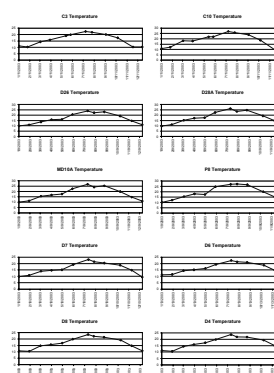


Figure 3-3 Water temperature (°C), 2003

Temperature minima at most sites during 2003 occurred during the months of December and January. The timing of these minima contrasts with results from the 2001-2002 study period, in which most sites' minima occurred in February (DWR 2004).

A water temperature maximum of 27.2 °C was recorded at station P8, in the south Delta. This maximum is the same as that recorded for the 2001-2002 study period (DWR 2004). Recorded temperatures exhibited strong seasonal variability, with cooling during the winter and warming during the summer.

Dissolved Oxygen

Dissolved oxygen (DO) was measured using the modified Winkler iodometric method described in Standard Methods (APHA 1992). A sample aliquot was collected at a depth of one meter. The samples were collected in 300-mL glass-stoppered bottles and immediately analyzed onboard.

During 2003, DO concentrations ranged from 3.3 mg/L at site P8 in the south Delta in February, to 11.8 mg/L at site MD10 in the east Delta in March (Figures 3-4 and 3-5). Strong seasonal trends were evident in most regions, with DO concentrations decreasing during the summer and rising in the winter. Seasonal changes were not as apparent as in previous years; however, sites C3, D26, D28A, D6, D7, and D8 continued to show reduced seasonal DO levels coinciding with warmer summer and fall water temperatures. An exception to this was noted at sites P8 and C10 in the south Delta. Both sites showed poor correlation between temperature and DO levels, and weak seasonal patterns. These sites also showed the greatest degree of variability in DO levels, varying by almost 7.0 mg/L over the year.

In the Suisun Bay, sites D6, D7 and D8 were closely related, and showed a yearly variation of about 2 mg/L, which was consistent with the range observed at most other sites.

Specific Conductance

Specific conductance, an estimate of salinity, was determined from samples collected at a depth of one meter. The samples were analyzed for specific conductance using a Seabird model CTD 911+ data logger, with temperature compensation to 25 °C.

Specific conductance varied greatly between sites monitored, ranging from 138 µS/cm at site C3 in the north Delta in January to 43,413 µS/cm at site D41 in San Pablo Bay in November (Figures 3-6 and 3-7). This range of specific conductance was less than the 74-45,107 µS/cm range reported for the 2001-2002 study period (DWR 2004).

Specific conductance generally increased from east to west and was well correlated to inflows and tidal action. Maximum values occurred in the late summer and fall when flows through the Delta were low and marine intrusion was most pronounced.

Sites with high average specific conductivity such as D4, D6, D7, D8 and D41 tended to show stronger seasonal variations, with specific conductance

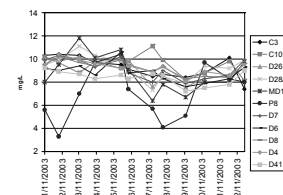


Figure 3-4 Dissolved oxygen

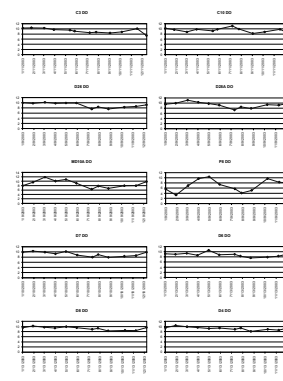


Figure 3-5 Dissolved oxygen (mg/L), 2003

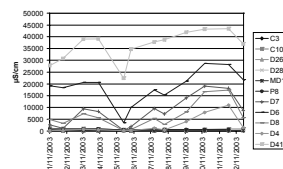


Figure 3-6 Specific conductance

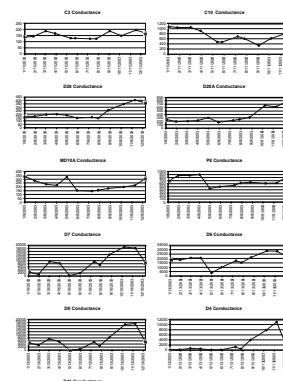


Figure 3-7 Specific conductance (µS/cm), 2003

varying from a low in May, to a high in October and November. At sites with lower specific conductance, this seasonal trend was less apparent.

Specific conductance dropped noticeably at most sites in May and December. Downstream sites showed the most variability, especially during winter. Upstream sites with low specific conductance, such as site C3, had the least variation and showed few or no apparent seasonal trends.

Secchi Disk Depth

Water transparency was measured to the nearest centimeter using a 20-cm diameter Secchi disk attached to a 2.5-m rod marked in cm. Secchi disk transparency was recorded as the average depth in which visual determination of the disk was lost as it was lowered into the water column, and the depth of its visual perception as it was raised.

A Secchi depth minima of 12 cm was recorded at sampling site D7, in the Suisun Bay in May (Figures 3-8 and 3-9). A Secchi depth maxima of 212 cm was recorded at sampling site D28A in the central Delta in December. By comparison, Secchi values during 2001-2002 ranged from 16-206 cm (DWR 2004). The long-term increase in transparency values noted in a previous report (DWR 2001) was not discernable in the 2003 data.

Secchi disk depth varied seasonally, with a marked decrease at all sites during December and January, and a gradual decrease during the summer months. Peak Secchi depths occurred in spring (March) and again in fall (October).

Overall, Secchi depths were lowest at sites D6, D7, D8, and D4, while sites C3, D28A, MD10, and D41 had the highest overall average Secchi depths. As noted earlier, Secchi disk depth measurements are not taken at site P8 in the south Delta, due to site restrictions.

Turbidity

Turbidity is a measure of the optical properties of water and substances contained in the water that cause light to be scattered and absorbed rather than transmitted in straight lines (APHA 1992). Turbidity is caused by soluble organic compounds, plankton, and suspended matter such as clay, silt, inorganic substances, and organic matter.

Turbidity was determined from samples collected at a depth of one meter. The samples were pumped through a Turner Model 10 flow-through nephelometer calibrated with a reference sample of formazin suspension at 40 nephelometric turbidity units (NTU) according to Standard Reference protocol 214-A (APHA 1992).

Turbidity varied greatly among sampled sites (Figures 3-10 and 3-11). Values ranged from 2.9 NTU at site D28A in October, to 71 NTU at site D7 in January. This range of turbidity was slightly less than the 1.3 to 86 NTU range reported for 2001 and 2002.

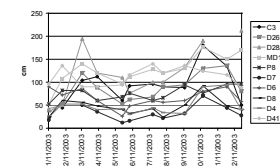


Figure 3-8 Secchi depth

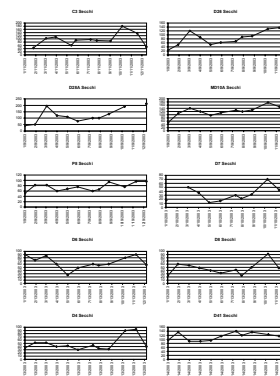


Figure 3-9 Secchi disk depth (cm), 2003

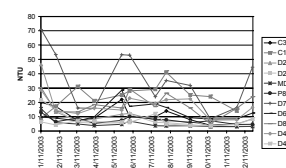


Figure 3-10 Turbidity

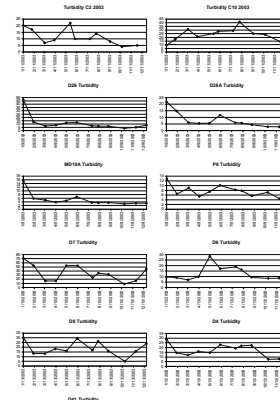


Figure 3-11 Turbidity (NTU), 2003

Turbidity levels at some sites exhibited a seasonal pattern of high turbidity in the early spring, followed by decreasing turbidity in late spring and fall; however, some sites showed no consistent seasonal pattern.

Most sites showed high or highest turbidity levels in January. This is consistent with previous reports of large increases in turbidity observed at most sites in January 2002 (DWR 2004). Exceptions to this occurred at sites C10, D6, and D41, where turbidity levels were low in January and peaked later between May and August. Sites in the Suisun Bay region (D6, D7 and D8) showed summer pulses of turbidity that appear to coincide with marked decreases in specific conductance. This suggests a possible relationship with increases in Delta outflows. Other sites showed similar pulses in turbidity with no apparent correlation with conductance.

Orthophosphate

Orthophosphate is soluble inorganic phosphate, the phosphorus compound most immediately available for assimilation by phytoplankton.

Orthophosphate concentrations were measured by first collecting sample aliquots from a 1-meter depth into new, rinsed polyethylene bottles. The water samples were then passed through a pre-washed membrane filter with a 0.45-micron pore size. The filtrate was immediately frozen and later transported to Bryte Laboratory² for analysis according to the EPA (1983) colormetric automated ascorbic acid method 365.1. The minimum reporting limit for orthophosphate was 0.01 mg/L.

Values for orthophosphate varied considerably between sites and across seasons (Figures 3-12 and 3-13). The lowest values, recorded in the east Delta at site MD10 in March and April 2003, showed orthophosphate levels below the detectable limit of 0.01 mg/L. The previous 2001-2002 study also showed the lowest values (<0.01 mg/L) of orthophosphate occurring at site MD10 during March and December 2002 (DWR 2004).

The highest value of orthophosphate, 0.29 mg/L, was recorded at site P8 in the south Delta in February 2003. In the previous 2001-2002 study, site P8 also showed the highest orthophosphate concentration (0.42 mg/L) in January 2002 (DWR 2004).

Orthophosphate levels were highest in the south Delta region (sites C10 and MD10A) and showed a common seasonal pattern, with high values from January to March, followed by a marked decline from April to July and another peak in later summer and early fall. All other sites had yearly values below 0.10 mg/L.

Total Phosphorus

Total phosphorus is the sum of all phosphorus compounds in the sample. This parameter includes phosphorus compounds that are bioavailable, as well as those that are not. Phosphorus that is unavailable for bioassimilation

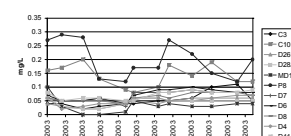


Figure 3-12 Orthophosphate

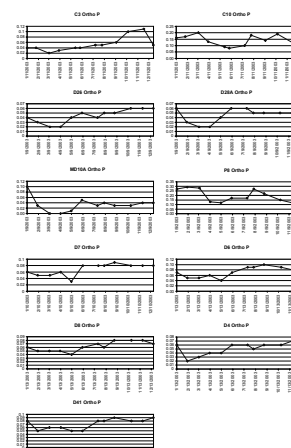


Figure 3-13 Orthophosphate (mg/L), 2003

² Bryte Chemical Laboratory, Department of Water Resources, 1450 Riverbank Road, West Sacramento, CA 95605

includes phosphorus compounds that are already incorporated into biological tissue and insoluble mineral particles.

Total phosphorus concentrations were measured by first collecting sample aliquots from a 1-meter depth into new, rinsed polyethylene bottles. The water samples were then passed through a pre-washed membrane filter with a 0.45-micron pore size. The filtrate was immediately frozen and later transported to Bryte Laboratory for analysis according to the EPA (1983) colorimetric semi-automated method 365.4. The minimum reporting limit for total phosphorus was 0.01 mg/L.

Values for total phosphorus varied considerably between sites and across seasons (Figures 3-14 and 3-15). Total phosphorus concentrations followed seasonal patterns and regional distributions similar to those reported for orthophosphate. The lowest value of 0.04 mg/L was recorded in the east Delta at site MD10 in March 2002. This value is identical to the minimum value recorded for the 2001-2002 period at the same site in January 2001 (DWR 2004). The highest values for total phosphorus were recorded in the south Delta at sites P8 and C10. A maximum value of 0.38 mg/L was recorded at site P8 in January 2003. This value is lower than the maximum values of 0.5 mg/L recorded between 2001 and 2002 in the south Delta region (DWR 2004).

Except for those in the south Delta region, all sites showed total phosphorus levels at or below 0.11 mg/L during the spring (March through May). Total phosphorus levels at these sites never exceeded 0.17 mg/L.

Kjeldahl Nitrogen

Kjeldahl nitrogen is nitrogen in the form of organic proteins or their decomposition product ammonia, as measured by the Kjeldahl method (APHA 1992).

Kjeldahl nitrogen concentrations were measured by first collecting sample aliquots from a 1-meter depth into new, rinsed polyethylene bottles. The water samples were then passed through a pre-washed membrane filter with a 0.45-micron pore size. The filtrate was immediately frozen and later transported to Bryte Laboratory for analysis according to the EPA (1983) colorimetric semi-automated method 352.1. The minimum reporting limit for Kjeldahl nitrogen is 0.01 mg/L.

Kjeldahl nitrogen concentrations ranged from 2.20 mg/L at station P8 in the south Delta in February, to undetectable levels (<0.01 mg/L) at sites P8 and C3 in October 2003 (Figures 3-16 and 3-17). Kjeldahl nitrogen levels during the 2001-2002 study period also peaked at site P8 with a high of 3.70 mg/L (DWR 2004).

Kjeldahl nitrogen concentrations were generally highest in the south Delta region (Sites P8 and C10). The two south Delta sites also showed the greatest variability. No strong seasonal or interannual trends were apparent among all the sites, although three sites (P8, C10 and C3) showed a sudden one-month marked decline in October 2003.

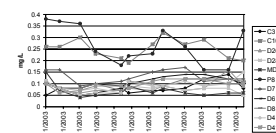


Figure 3-14 Total phosphorus

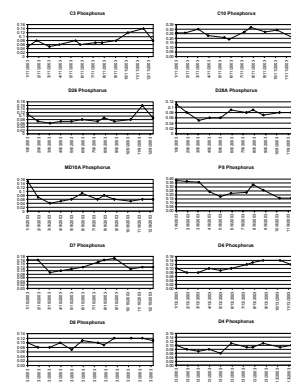


Figure 3-15 Total phosphorus (mg/L), 2003

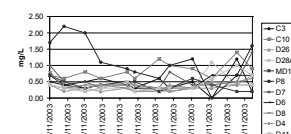


Figure 3-16 Kjeldahl nitrogen

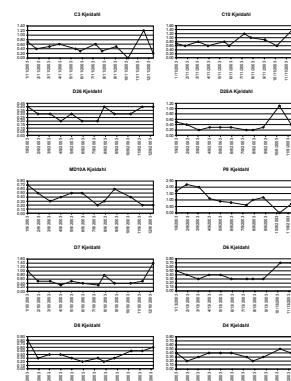


Figure 3-17 Kjeldahl nitrogen (mg/L), 2003

Dissolved Inorganic Nitrogen

Dissolved inorganic nitrogen (DIN) is a measure of total ammonia (NH_3), nitrate (NO_3), and nitrite (NO_2), the nitrogen forms immediately available for assimilation by phytoplankton. DIN was measured by first pumping water samples from a 1-meter depth into new, rinsed polyethylene bottles. The water samples were then passed through a pre-washed membrane filter with a 0.45-micron pore size. The filtrate was immediately frozen and later transported to Bryte Laboratory for analysis for total ammonia according to the EPA (1983) colormetric, automated, phenate method 350.1; and for nitrate and nitrite according to the colormetric automated cadmium reduction method 353.2 (EPA 1983). DIN was calculated as the sum of total ammonia plus nitrate and nitrite. The minimum reporting limit for DIN was 0.01 mg/L.

DIN concentrations ranged from 4.70 mg/L in the south Delta (site P8) in February to 0.07 mg/L in the east Delta (site MD10) in September (Figures 3-18 and 3-19). These DIN values were similar to results obtained in 2001-2002, which recorded a maximum of 4.8 mg/L at P8 and a minimum value of 0.14 mg/L at station MD10.

DIN values were consistently high in the south Delta stations C10 and P8, as compared to other stations, with almost all values greater than 1.0 mg/L. In contrast all other stations had most DIN values below 1.0 mg/L and a majority of values below 0.05 mg/L. The high values observed in the south Delta may be due to runoff and drainage from agricultural operations on the San Joaquin River.

Concentrations in the south Delta also showed the greatest degree of seasonal variability. By contrast, DIN concentrations in the Suisun Bay (D6, D7, and D8) showed only minor seasonal variations. All regions showed some seasonal variation with DIN values lowest in August and September, when water temperatures and phytoplankton growth were highest and inflows were lowest, followed by increases in late fall and winter.

Dissolved Organic Nitrogen

Organic nitrogen is defined functionally as nitrogen that is bound to carbon-containing compounds in the tri-negative oxidation state (APHA 1992). This form of nitrogen must be mineralized or decomposed before it can be used by aquatic and terrestrial plants. It does not include all organic nitrogen compounds, but does include proteins, peptides, nucleic acids, urea, and numerous synthetic organic compounds (APHA 1992).

Dissolved organic nitrogen (DON) was measured by first pumping water samples from a 1-meter depth into new, rinsed polyethylene bottles. The water samples were then passed through a pre-washed membrane filter with a 0.45-micron pore size. The filtrate was immediately frozen and later transported to Bryte Laboratory for analysis according to the EPA (1983) colormetric, semi-automated method 351.2. The minimum reporting limit for DON was 0.10 mg/L.

DON concentrations ranged from 1.80 mg/L at station P8 in the east Delta in March to concentrations below detectable levels (< 0.10 mg/L) at station D4

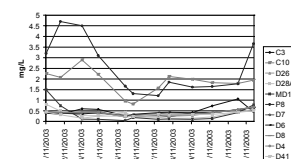


Figure 3-18 Dissolved inorganic nitrogen

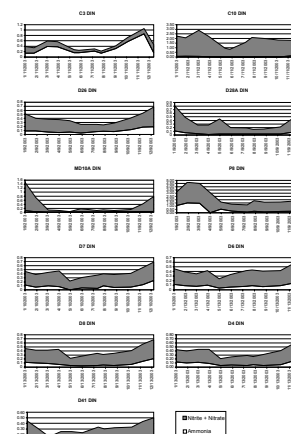


Figure 3-19 Dissolved inorganic nitrogen (mg/L), 2003

in February 2003 (Figures 3-20 and 3-21). Peak DON levels during 2001-2002 were considerably lower, reaching 1.10 mg/L at station MD10 in January 2002 (DWR 2004).

DON concentrations showed no clear seasonal or intra-annual pattern of variation; however, most sites showed increases in DON concentrations during the winter, and most sites had consistently low DON during April 2003.

Total Dissolved Solids

Total dissolved solids (TDS) is a measure of the solid fraction of a sample able to pass through a filter. The value of dissolved solids gives a general indication of the suitability of the water as a drinking source and for certain agricultural and industrial uses. Waters with high dissolved solids are of inferior palatability and may induce an unfavorable physiological reaction in consumers (APHA 1992).

TDS were measured by first pumping water samples from a 1-meter depth into new, rinsed polyethylene bottles. The samples were then filtered through a pre-washed membrane filter with a 0.45-micron pore size. The filtrate was immediately frozen and later transported to Bryte Laboratory for analysis, using EPA (1983) method 160.1.

TDS in the Bay-Delta varied over a wide range from 33,060 mg/L in the San Pablo Bay (site D41) in December to 76 mg/L in the north Delta (site C3) in August 2003 (Figures 3-22 and 3-23). The values and locations of maxima and minimum TDS were similar to results obtained during 2001-2002. The high values seen in San Pablo Bay are likely due to tidal influences of seawater with high TDS entering the Delta at San Pablo Bay. The lower TDS values seen at site C3 are due to spring flows of low TDS freshwater entering the Delta from the Sacramento Valley basin.

All sites subject to significant tidal exchange (that is, sites D41, D6, D7, D8, and D4) showed increasing TDS concentrations the closer they were to the coast. Aside from site D41, these sites also showed high seasonal variability in TDS concentrations. For these sites, low TDS values occurred in May and highest values occurred at year's end.

Total Suspended Solids

Suspended solids are the solids present in a water sample that are retained on a filter after the sample is filtered. Suspended solids include a wide variety of material such as silt, living or decaying organic matter, and anthropogenic matter. High amounts of suspended solids block light penetration into the water column and increase heat absorption.

Total suspended solids (TSS) may increase in surface waters due to increases in flow rate, as higher velocities increase water's capacity to suspend solids. Runoff from heavy rains can simultaneously introduce large amounts of solids into surface waters and provide the capacity for their suspension. Therefore, suspended solids concentrations can vary significantly over relatively short time periods.

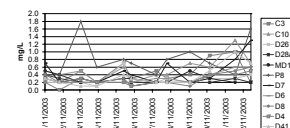


Figure 3-20 Dissolved organic nitrogen

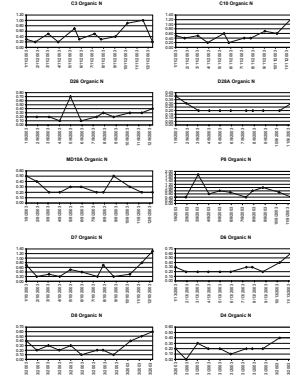


Figure 3-21 Dissolved organic nitrogen (mg/L), 2003

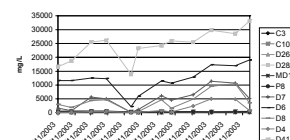


Figure 3-22 Total dissolved solids

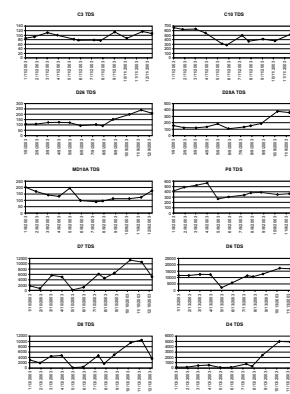


Figure 3-23 Total dissolved solids (mg/L), 2003

Water samples for TSS analysis were taken from aliquots collected from a depth of 1 meter, stored in polyethylene bottles, and refrigerated at 4 °C until analyzed at Bryte Laboratory using EPA (1983) method 160.2.

TSS in the San Francisco Bay-Delta varied over a wide range from 96 mg/L in Suisun Bay in February to 2.0 mg/L at several sites in March and October 2003 (Figures 3-24 and 3-25). These results are in contrast to the previous study period, 2001-2002, where the highest TSS values were recorded in the north Delta (118 mg/L) and the lowest TSS values were below the recording limit of 1 mg/L at several sites (DWR 2004).

TSS values at most sites showed “pulse” increases at various times during the year. These increases did not show any discernable seasonal pattern. Although winter pulse variations may be due to rain or hydrological events, variations in TSS at other times may reflect changing levels of organic matter.

Volatile Suspended Solids

The measurement of volatile suspended solids (VSS) provides a relative indicator of the amount of organic matter present in the water sample. Water samples for VSS analysis were taken from aliquots collected from a depth of 1 meter, stored in polyethylene bottles and refrigerated at 4 °C until analyzed at Bryte Laboratory. Samples were analyzed for VSS according to EPA Method 160.4 (EPA 1983). The minimum reporting level for VSS in these analyses was 1.0 mg/L.

VSS levels occasionally fell below minimum reporting levels (<1 mg/L) in most regions, and reached a high of 12.0 mg/L in the south Delta (site C10) in July (Figures 3-26 and 3-27). These results were similar to those observed in the previous reporting period from 2001-2002 (DWR 2004). Sites C10 in the south Delta and C3 in the north Delta showed the highest degree of variability, with VSS levels ranging from 1.0 to 12.0 mg/L. Other sites showed a narrower range of values; however, no apparent seasonal variation was seen in these data.

Silica

Water samples for silica analysis were taken from aliquots collected from a depth of 1 meter, stored in polyethylene bottles and refrigerated at 4°C until analyzed at Bryte Laboratory. Samples were analyzed for silica according to EPA Method 200.7 (EPA 1983). The minimum reporting level for silica in these analyses was 0.1 mg/L.

Silica concentrations ranged from 26 mg/L in Suisun Bay (site D6) in January to 4.8 mg/L in San Pablo Bay (site D41) in March 2003 (Figures 3-28 and 3-29). These values are similar to those observed in the previous 2001-2002 reporting period (DWR 2004). In comparison with the 2001-2002 period, silica values appeared less variable; however, the apparent seasonal trend of declining silica levels in spring months followed by increased silica concentrations in late summer and winter was also observed at the majority of sites.

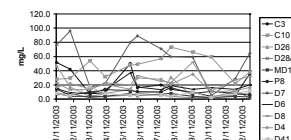


Figure 3-24 Total suspended solids

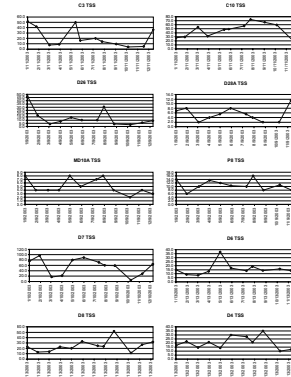


Figure 3-25 Total suspended solids (mg/L), 2003

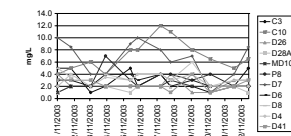


Figure 3-26 Volatile suspended solids

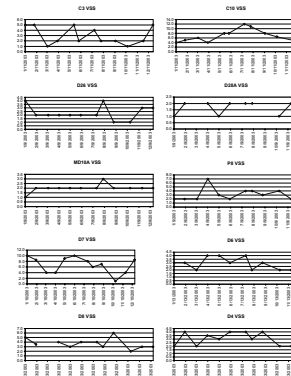


Figure 3-27 Volatile suspended solids (mg/L), 2003

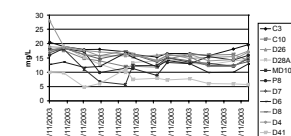


Figure 3-28 Silica

Chloride

Water samples for chloride analysis were taken from aliquots collected from a depth of 1 meter, stored in polyethylene bottles and refrigerated at 4 °C until analyzed at Bryte Laboratory. Samples were analyzed for chloride according to EPA Method 300.0 (EPA 1983).

Chloride concentrations in the Bay-Delta varied over a wide range from 16,500 mg/L in San Pablo Bay (site D41) in November to 3 mg/L in the north Delta (site C3) in August (Figures 3-30 and 3-31). These results are very similar to those observed in the 2001-2002 reporting period, which recorded 17,200 mg/L chloride in the San Pablo Bay in January 2001 and 4 mg/L in the north Delta in July 2002 (DWR 2004). The high values seen in San Pablo Bay are likely due to tidal influences of seawater entering the Delta, while the low values seen at site C3 are likely due to spring flows of fresh water down the Sacramento River. Values of chloride concentrations are closely correlated to values reported for specific conductance and total dissolved solids (TDS) reported earlier in this report.

Summary

The Department's monitoring and reporting of water quality data shown here is mandated in order to ensure compliance with water quality objectives; identify meaningful changes potentially related to the operation of the State Water Project and the Central Valley Project; and to reveal trends in ecological changes potentially related to project operations. Flow rates, influenced by natural forces and project operations, are a primary determinant of water quality dynamics at each site described. However, flow rates are not measured as part of this sampling protocol, and therefore a more analytical treatment of these data in relation to flow rates is not included. These data are presented as a snapshot of the system. They allow a historic comparison of a wide range of water quality parameters and show an overall consistency with recent years.

References

- [APHA] American Public Health Association. 1992. *Standard Methods for the Examination of Water and Wastewater*. 18th Edition, Washington DC.
- [DWR] California Department of Water Resources. 2001. *Water Quality Conditions in the Sacramento-San Joaquin Delta during 1996*.
- [DWR] California Department of Water Resources. 2003. *Water Quality Conditions in the Sacramento-San Joaquin Delta during 1997- 2000*.
- [DWR] California Department of Water Resources. 2004. *Water Quality Conditions in the Sacramento-San Joaquin Delta during 2001-2002*.
- [EPA] U.S. Environmental Protection Agency. 1983. *Methods for Chemical Analysis of Water and Wastes*. Technical Report EPA-600/4-79-020.

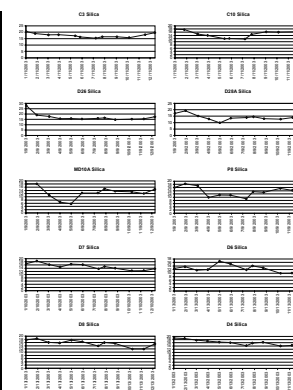


Figure 3-29 Silica (mg/L), 2003

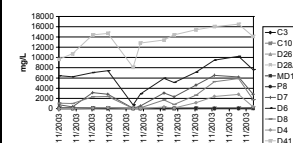


Figure 3-30 Chloride

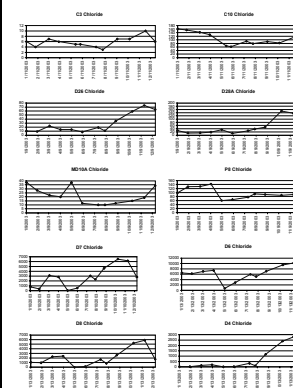
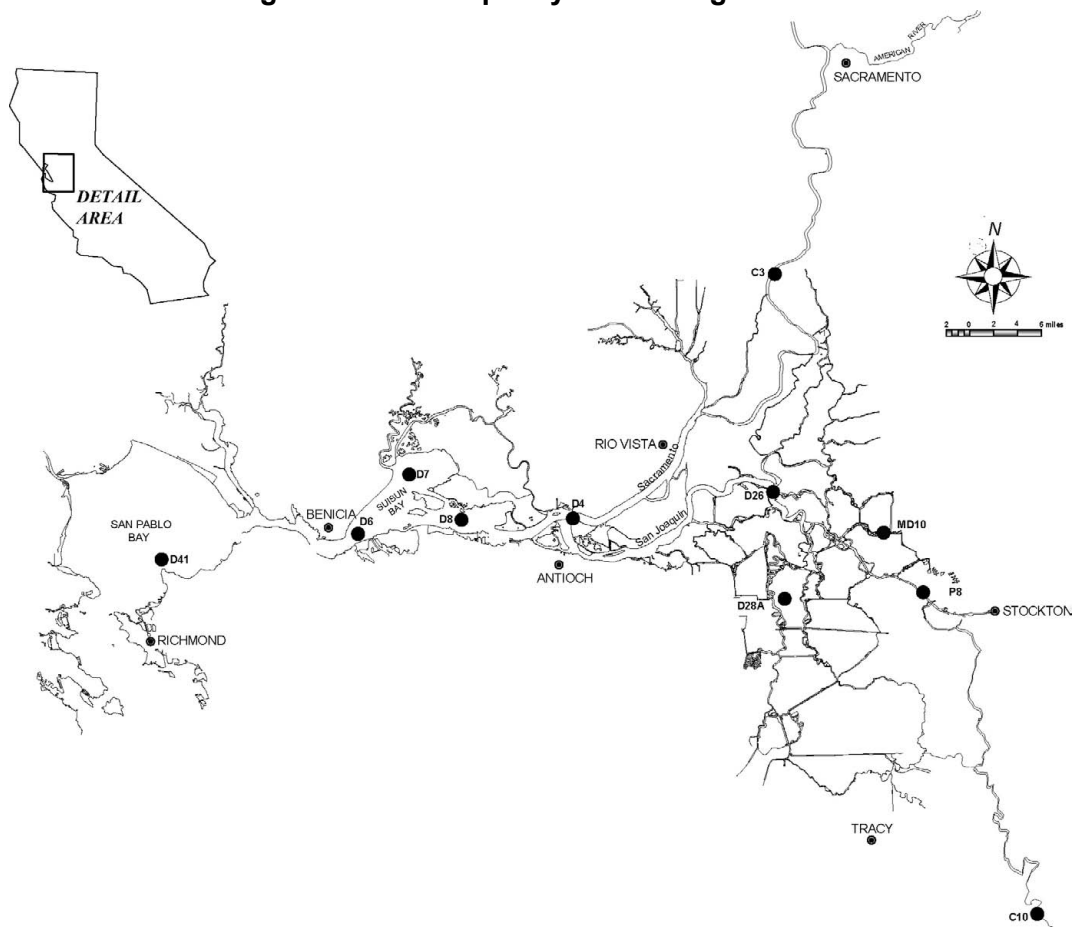


Figure 3-31 Chloride (mg/L), 2003

Figure 3-1 Water quality monitoring stations



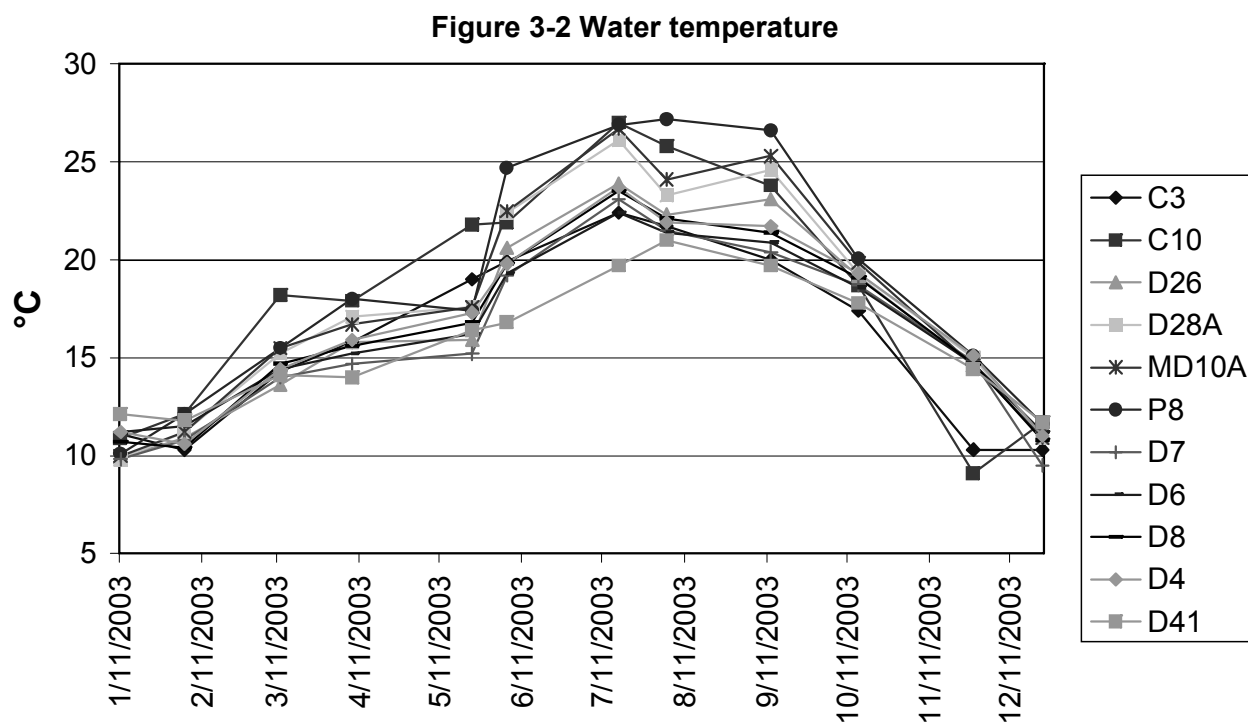


Figure 3-3 Water temperature (°C), 2003

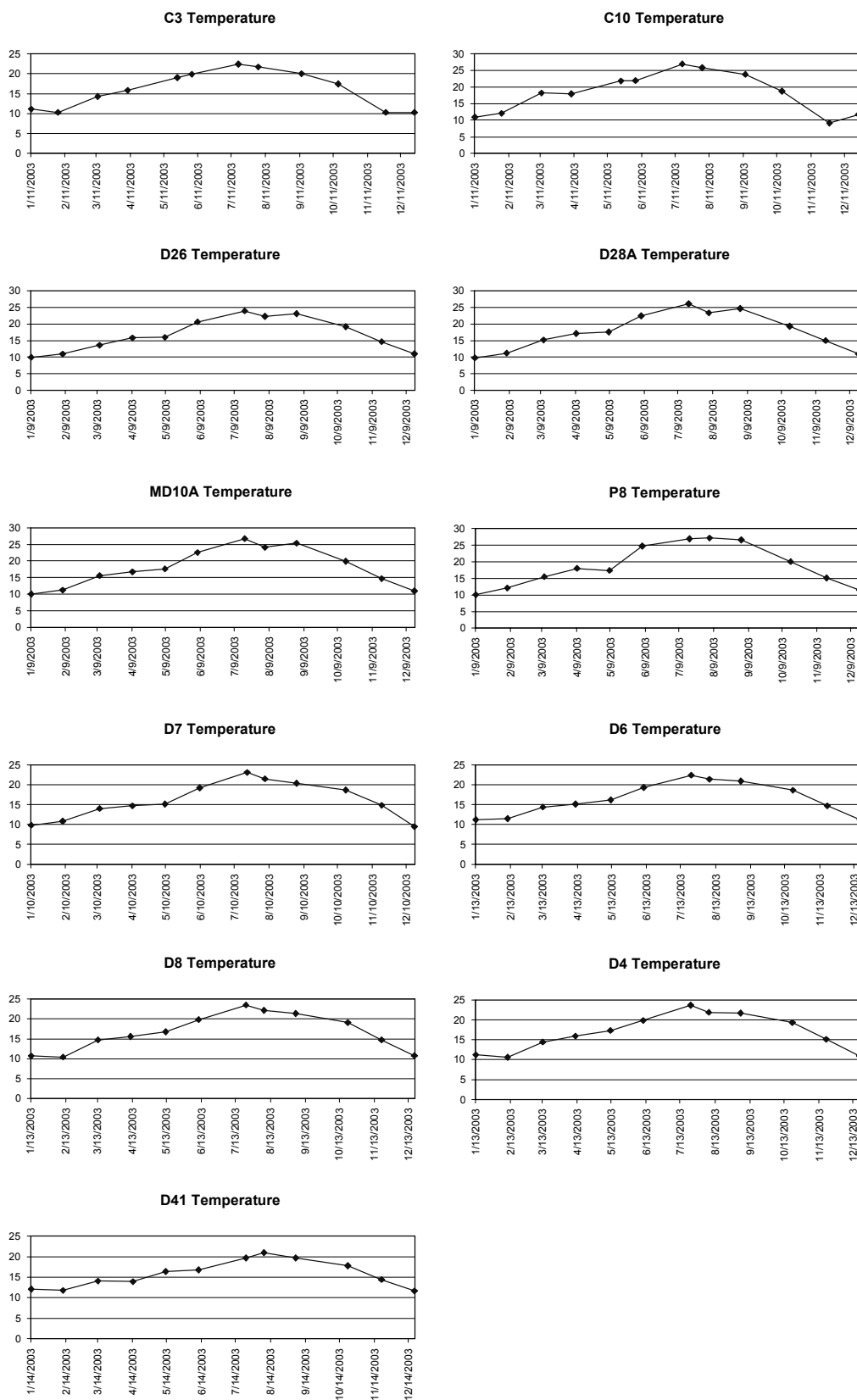


Figure 3-4 Dissolved oxygen

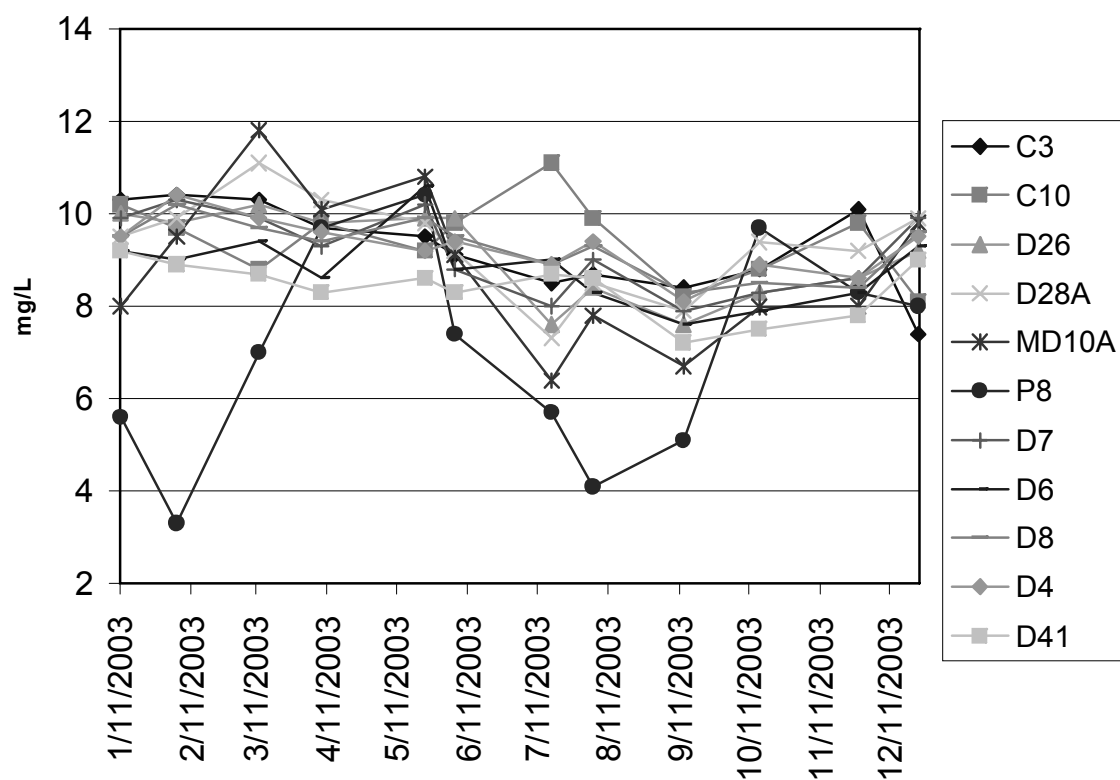


Figure 3-5 Dissolved oxygen (mg/L), 2003

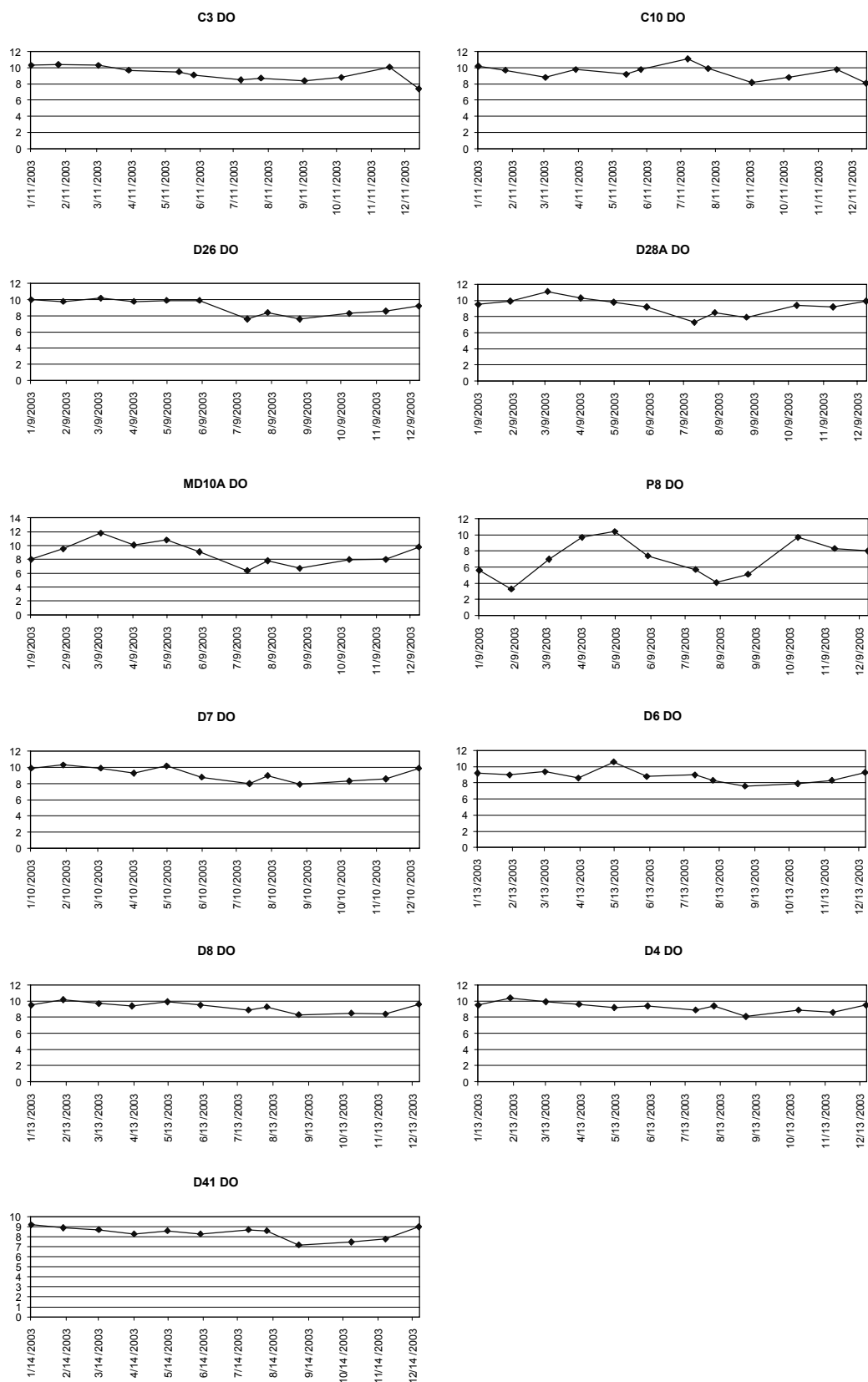


Figure 3-6 Specific conductance

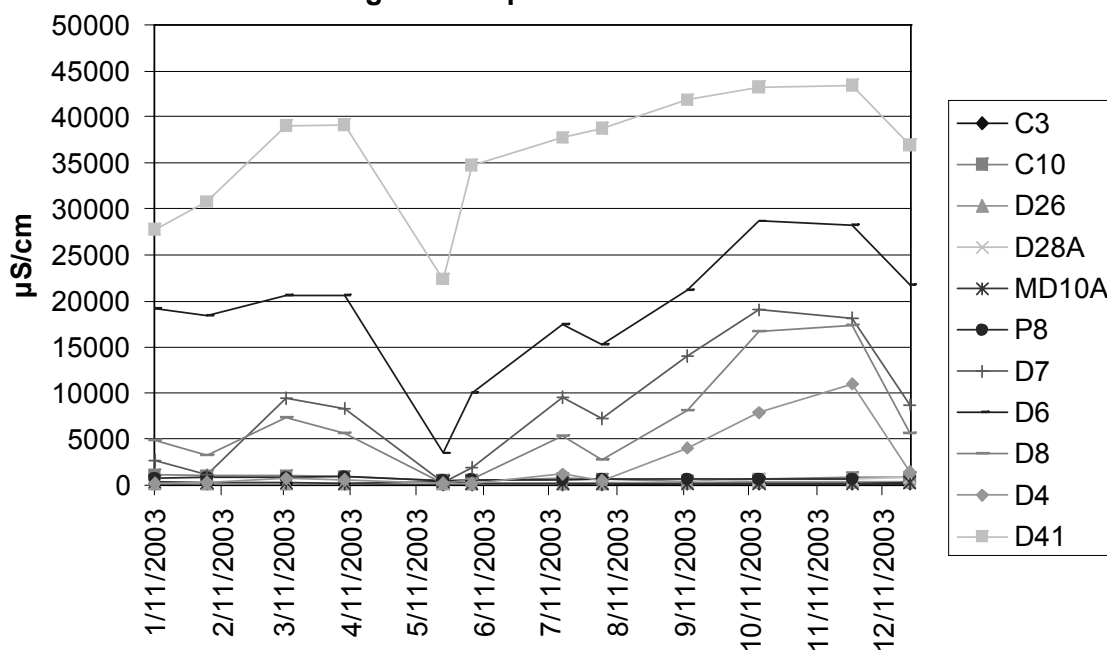


Figure 3-7 Specific conductance ($\mu\text{S}/\text{cm}$), 2003

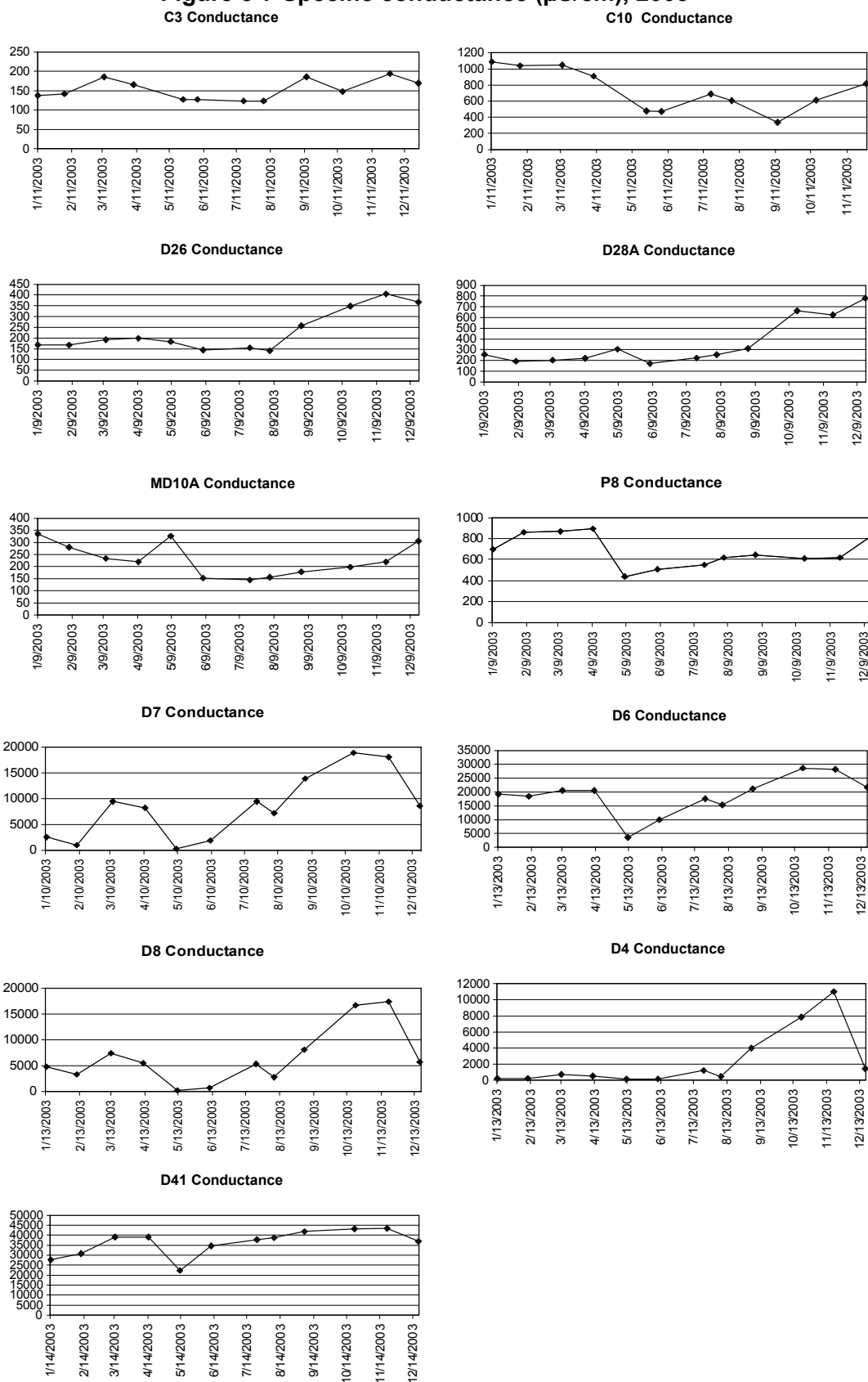


Figure 3-8 Secchi depth

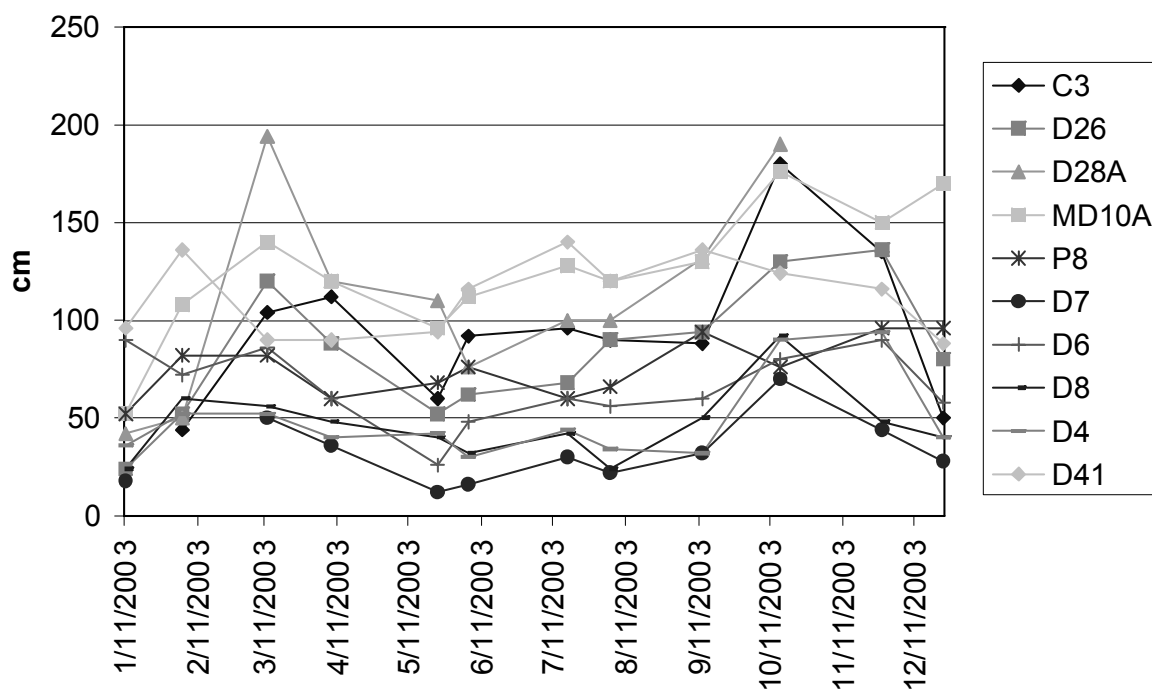


Figure 3-9 Secchi disk depth (cm), 2003

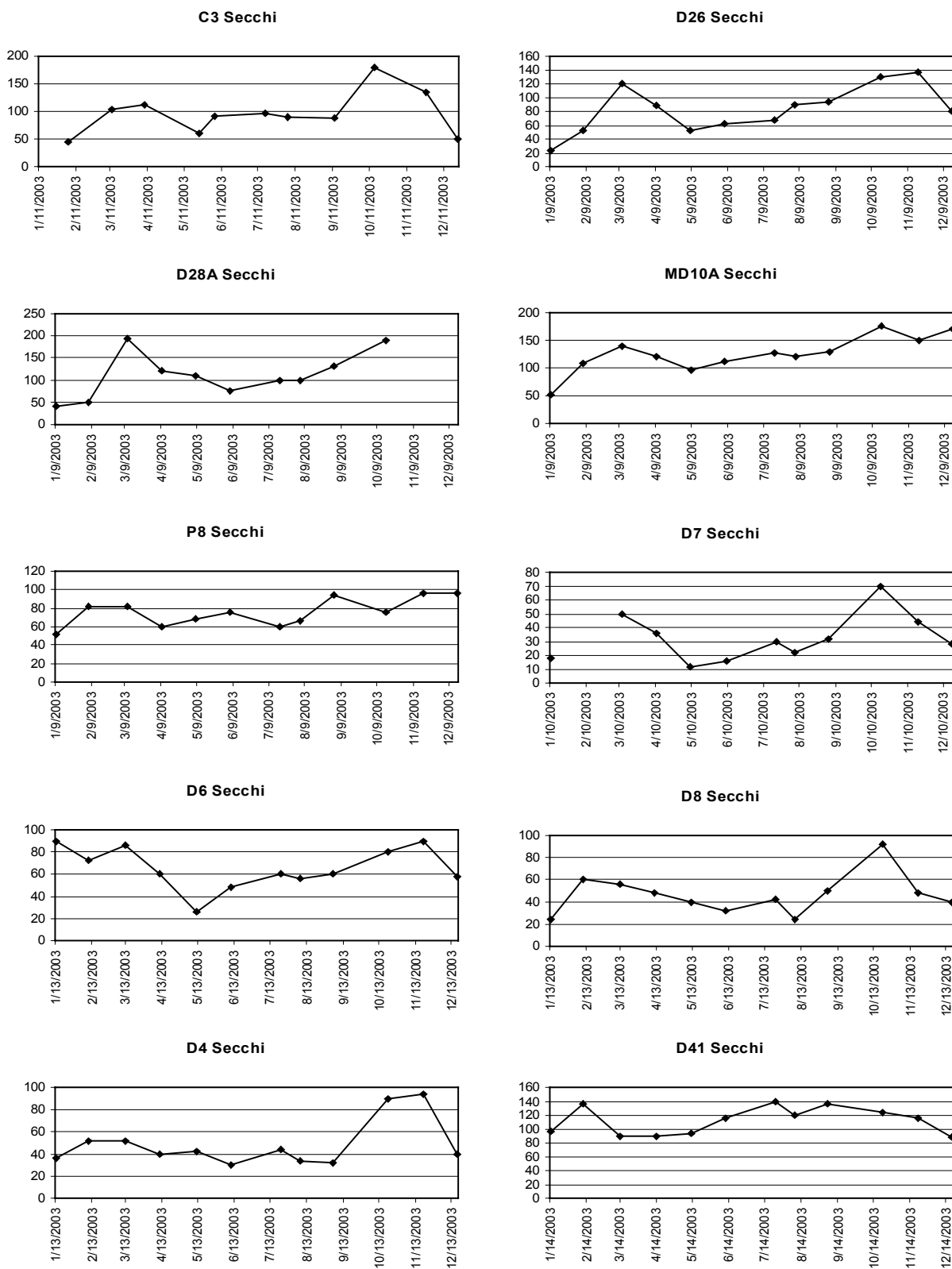


Figure 3-10 Turbidity

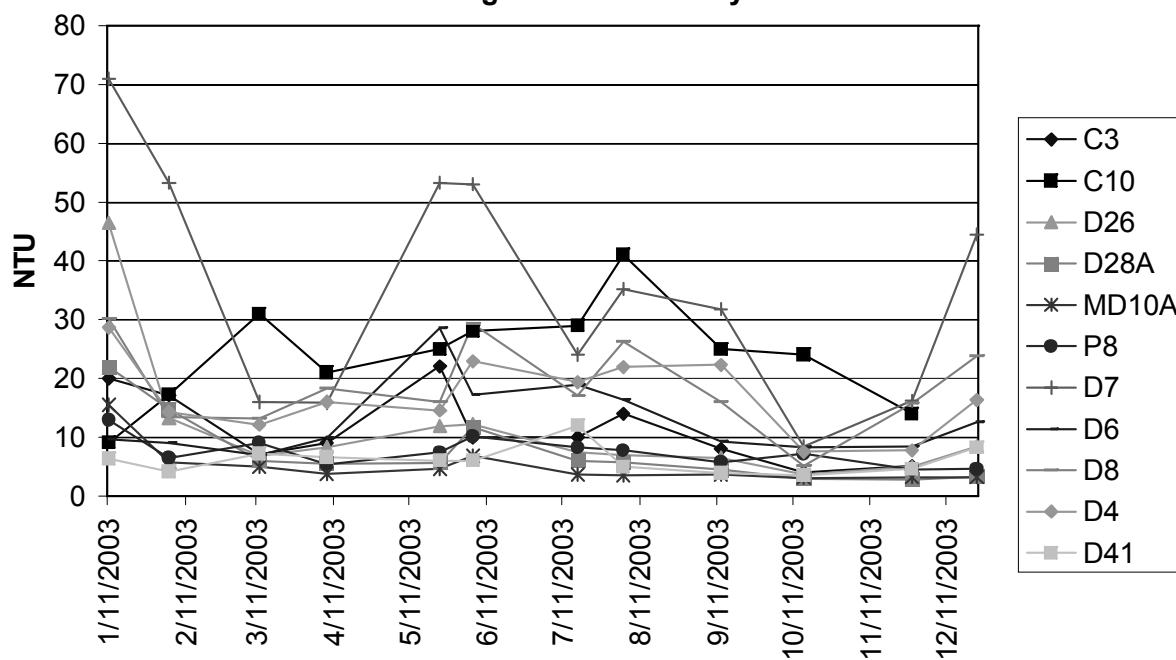


Figure 3-11 Turbidity (NTU), 2003

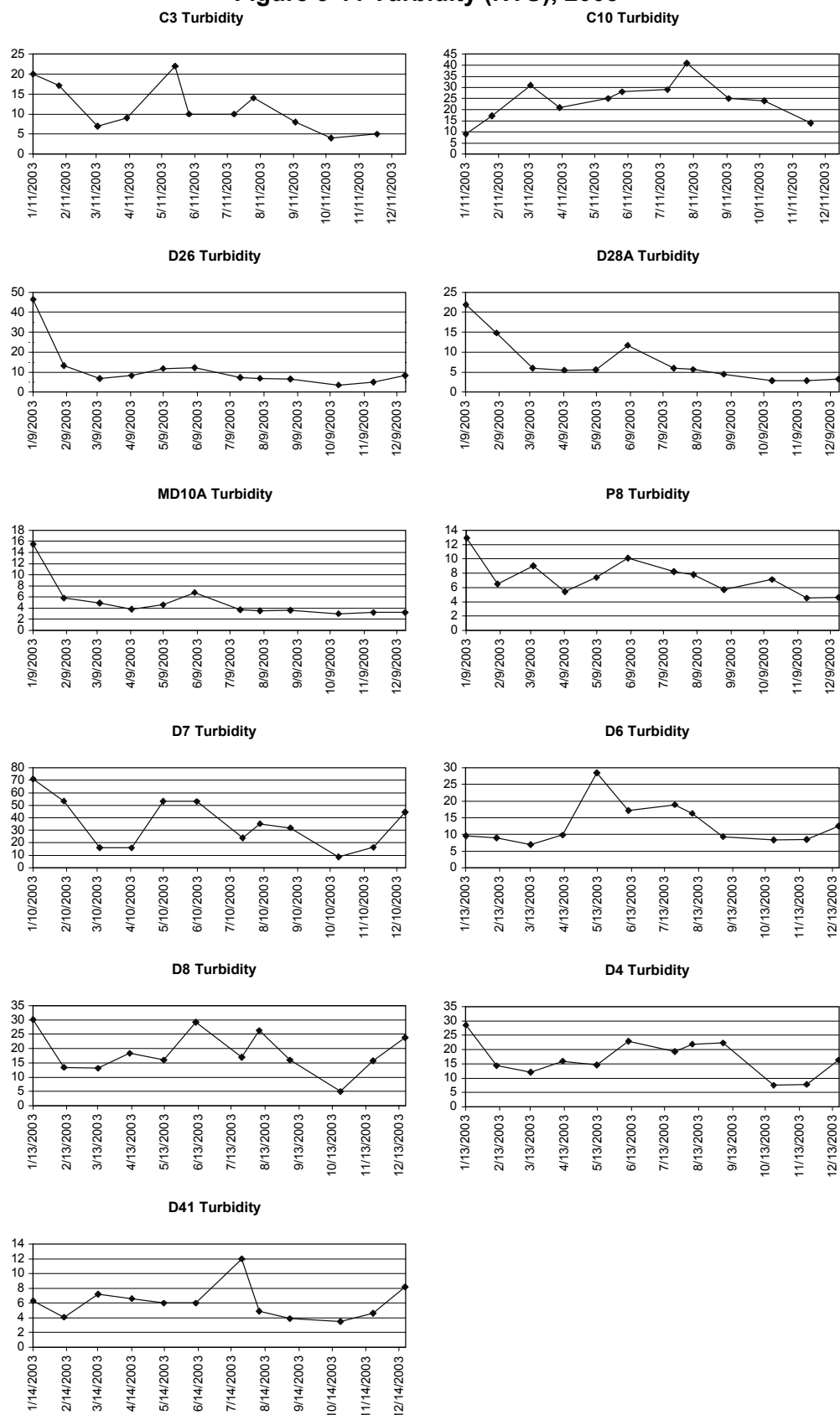


Figure 3-12 Orthophosphate

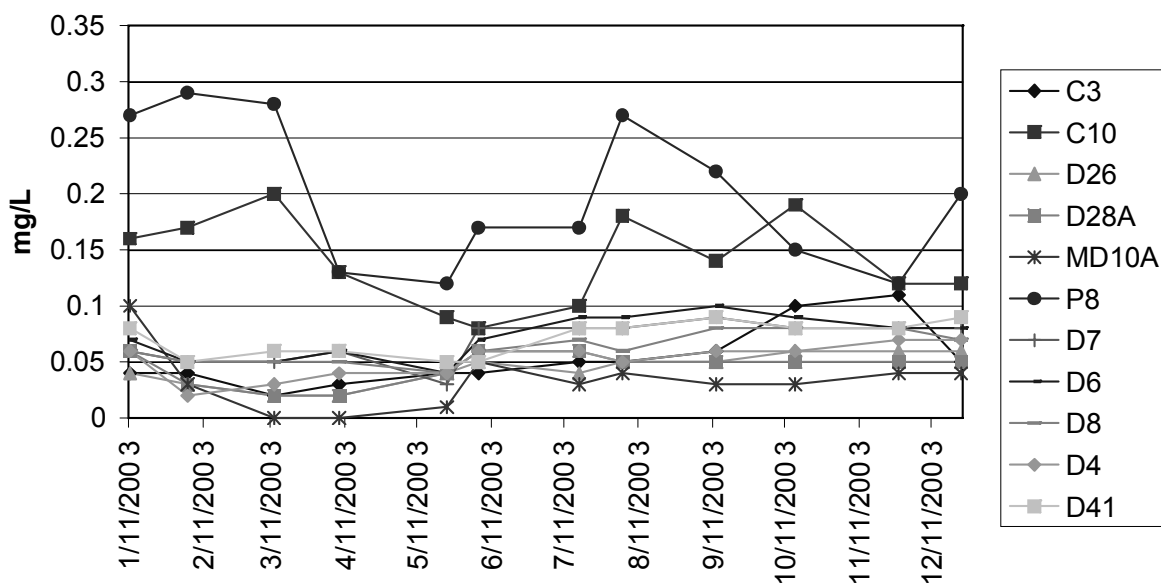


Figure 3-13 Orthophosphate (mg/L), 2003

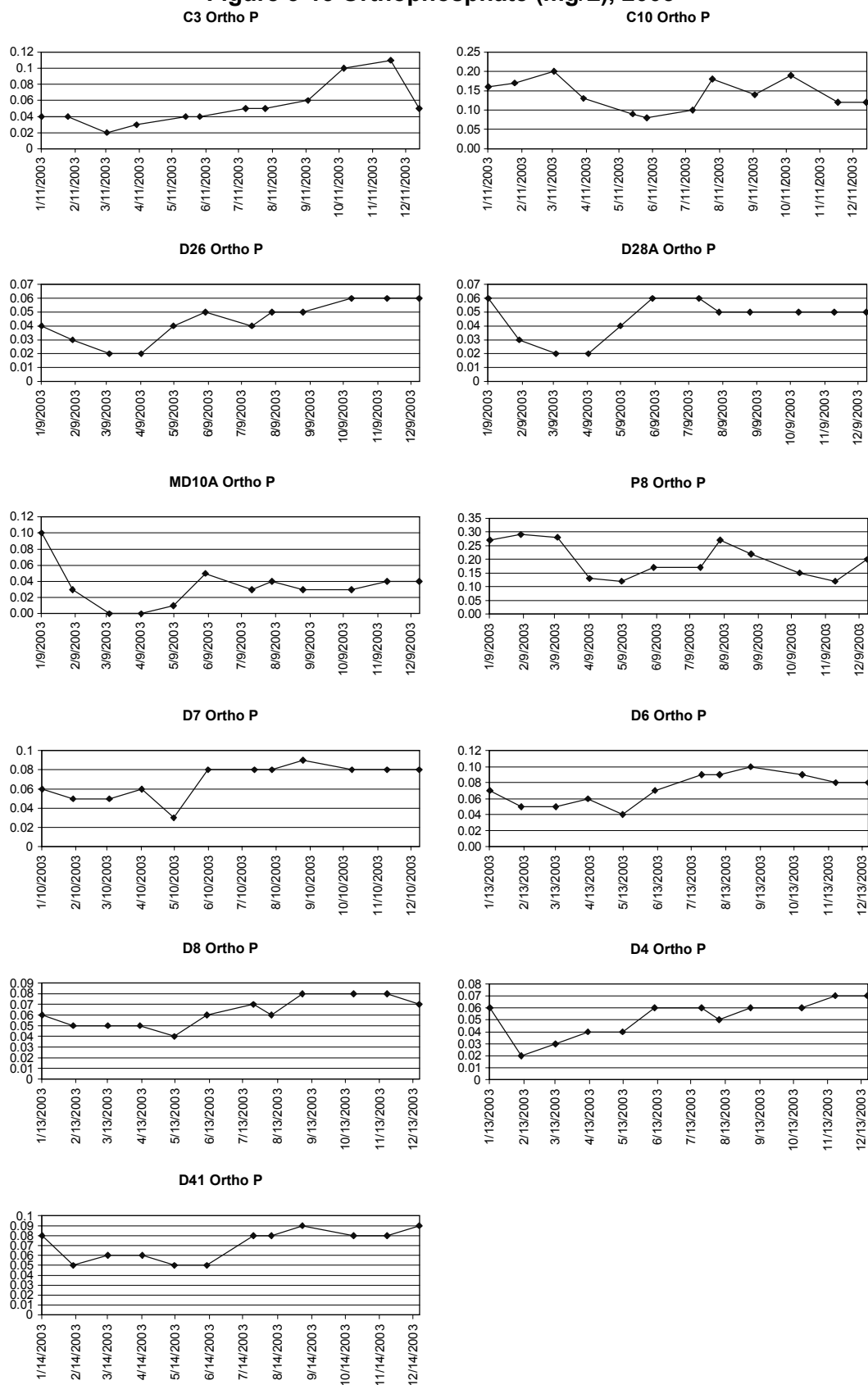


Figure 3-14 Total phosphorus

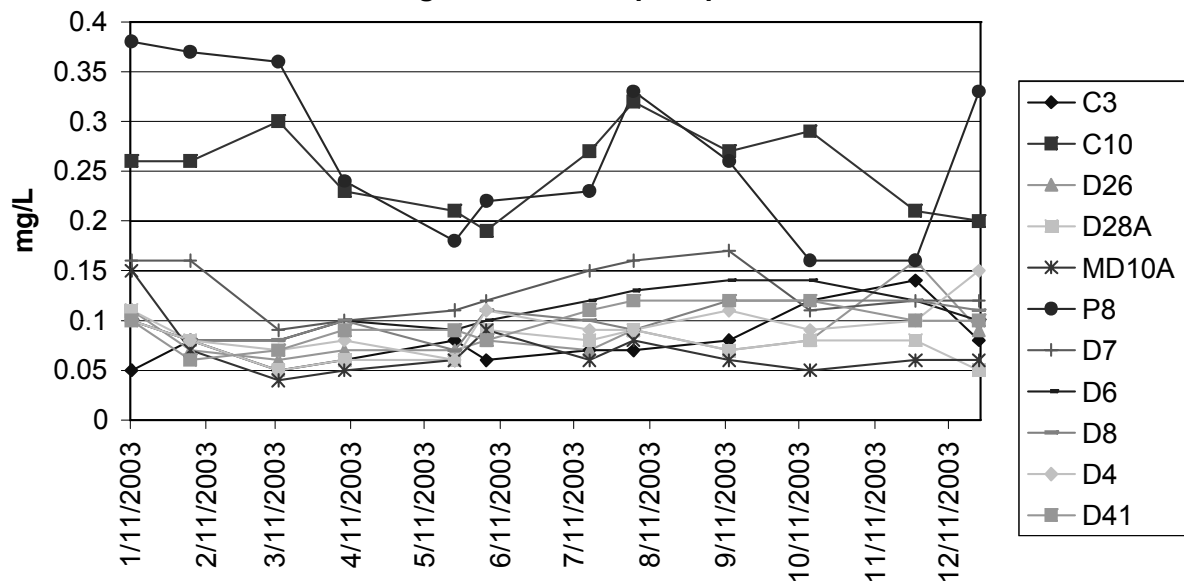


Figure 3-15 Total phosphorus (mg/L), 2003

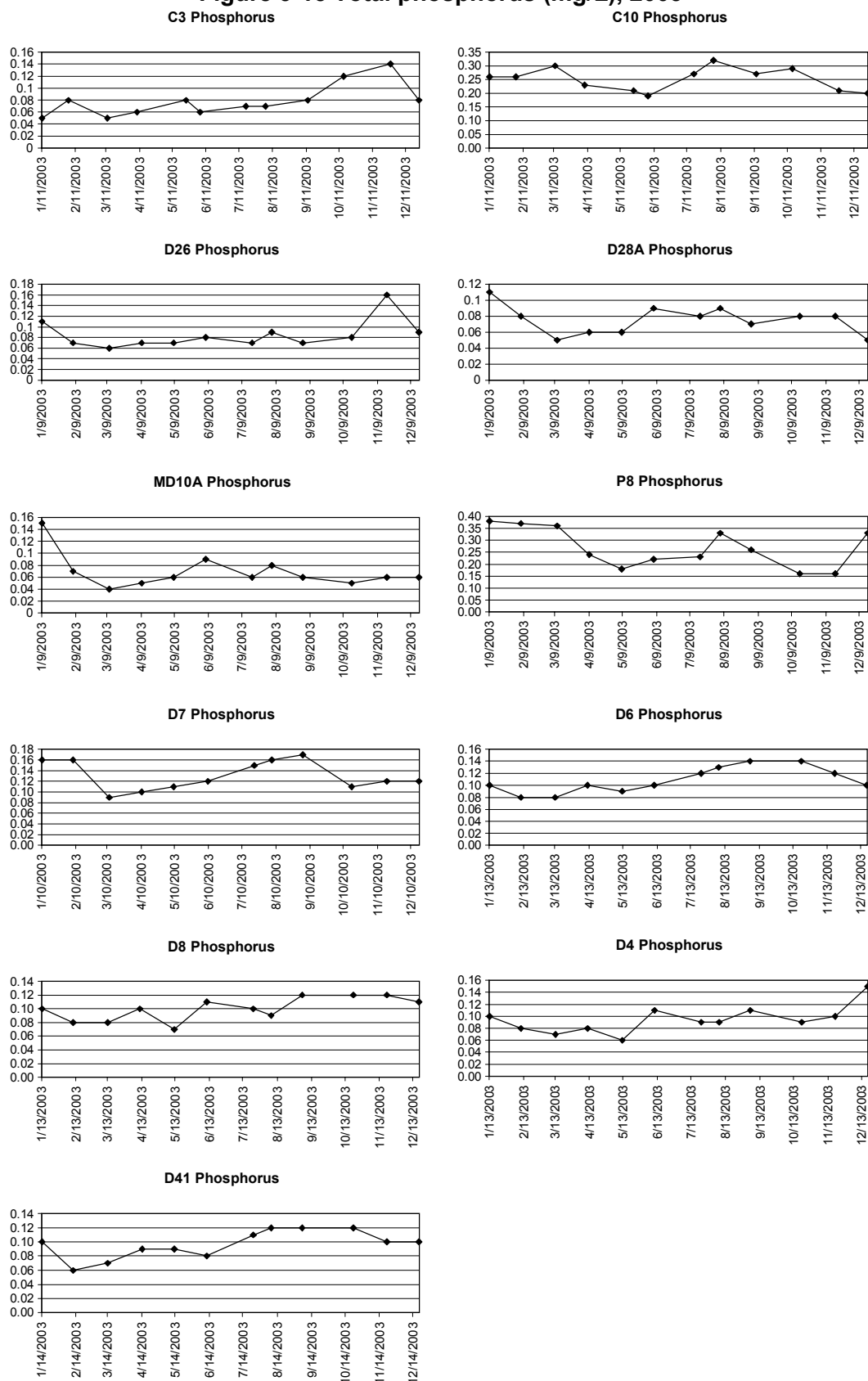


Figure 3-16 Kjeldahl nitrogen

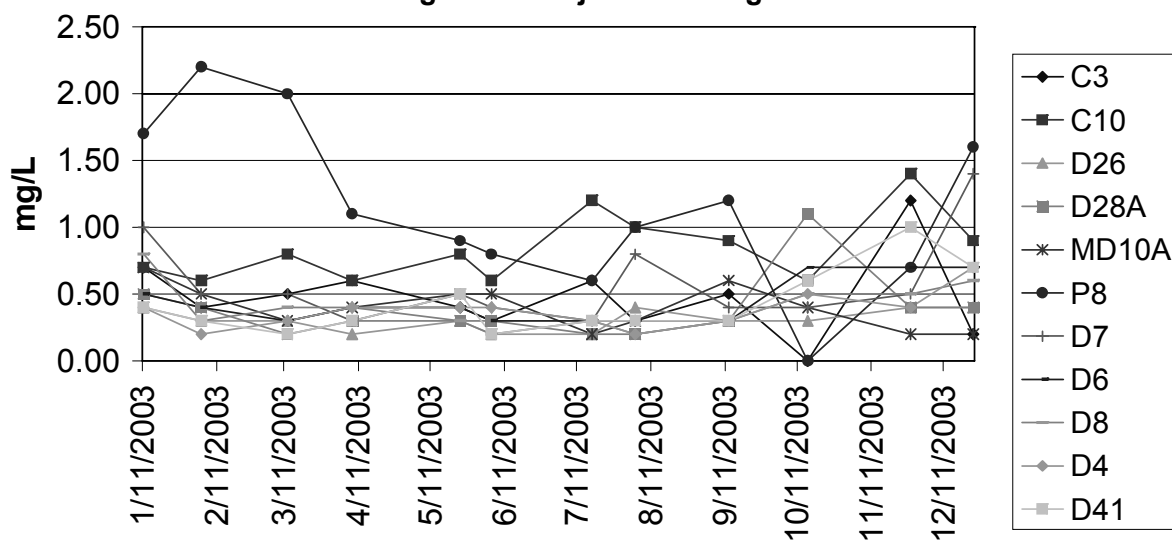


Figure 3-17 Kjeldahl nitrogen (mg/L), 2003

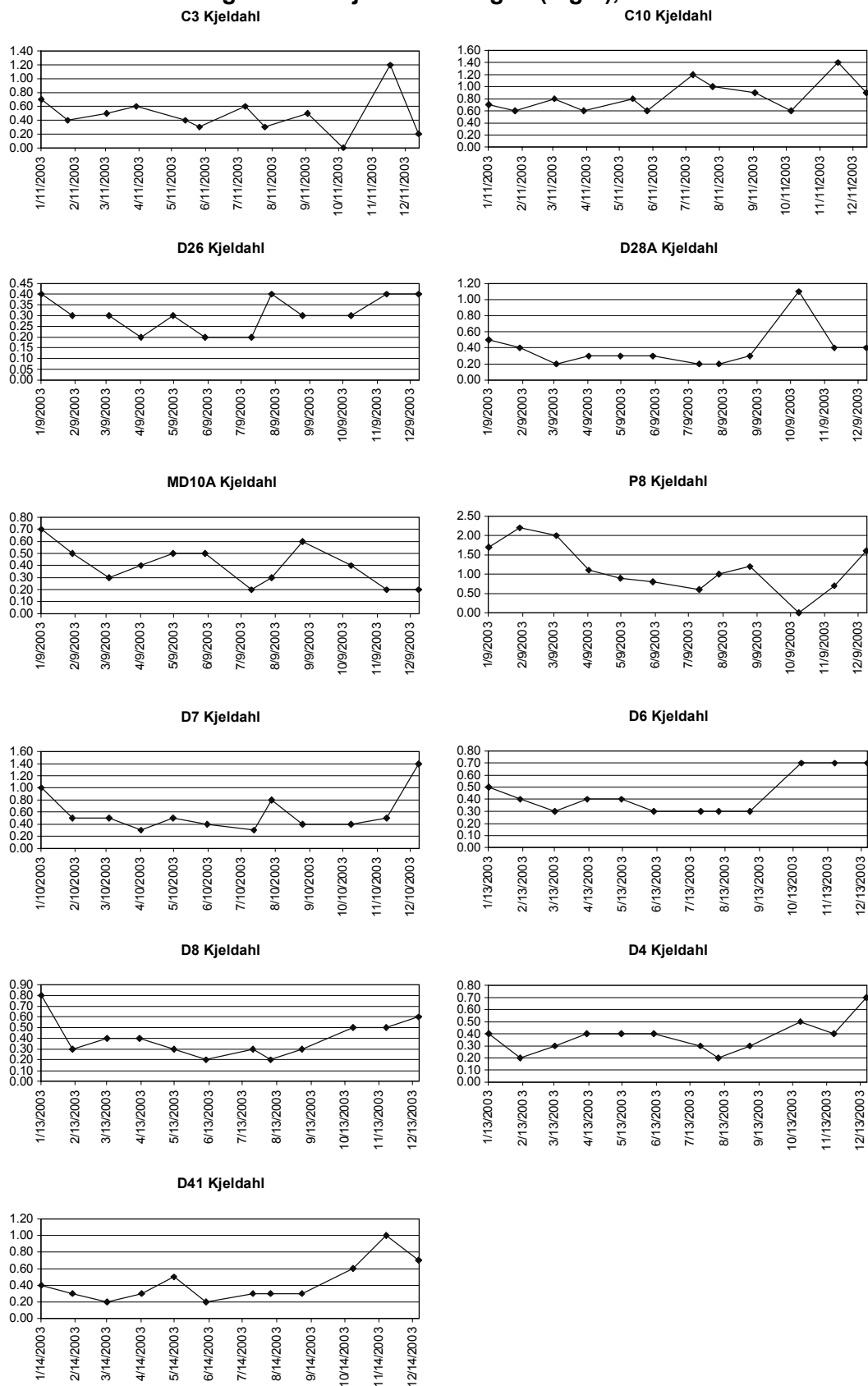


Figure 3-18 Dissolved inorganic nitrogen

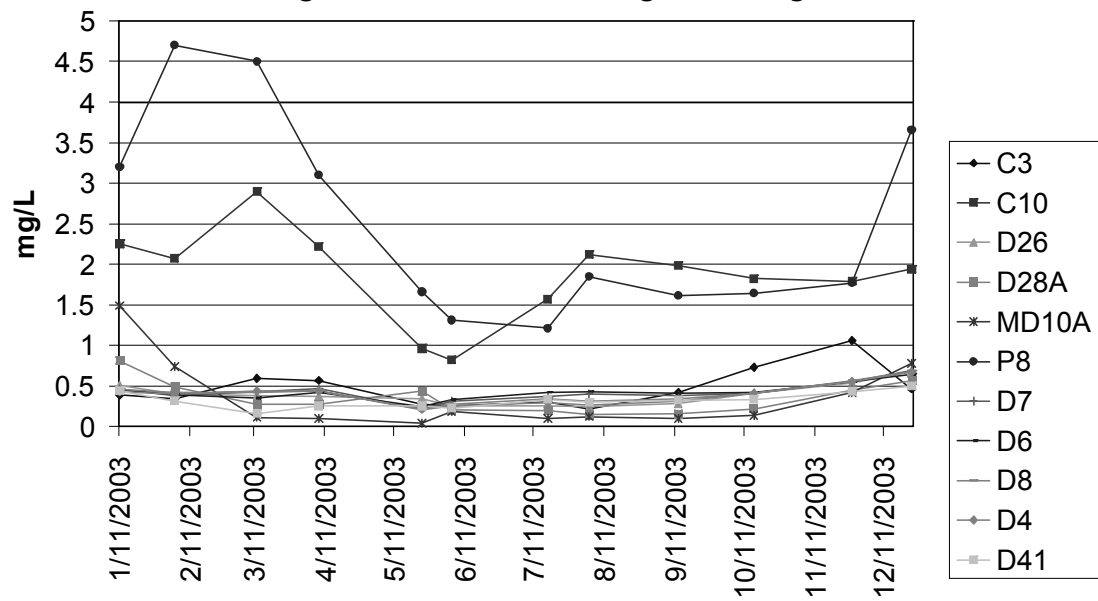


Figure 3-19 Dissolved inorganic nitrogen (mg/L), 2003

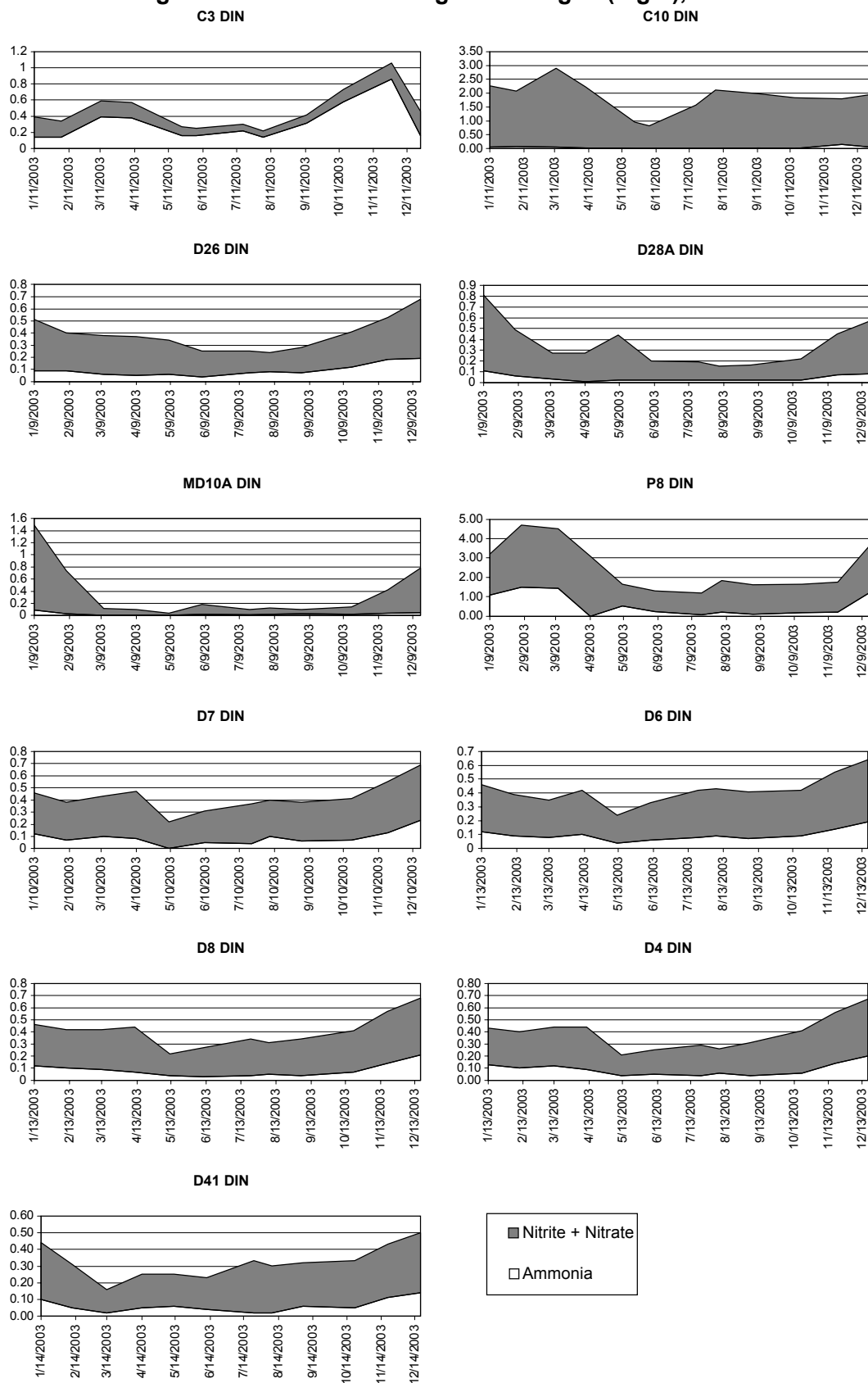


Figure 3-20 Dissolved organic nitrogen

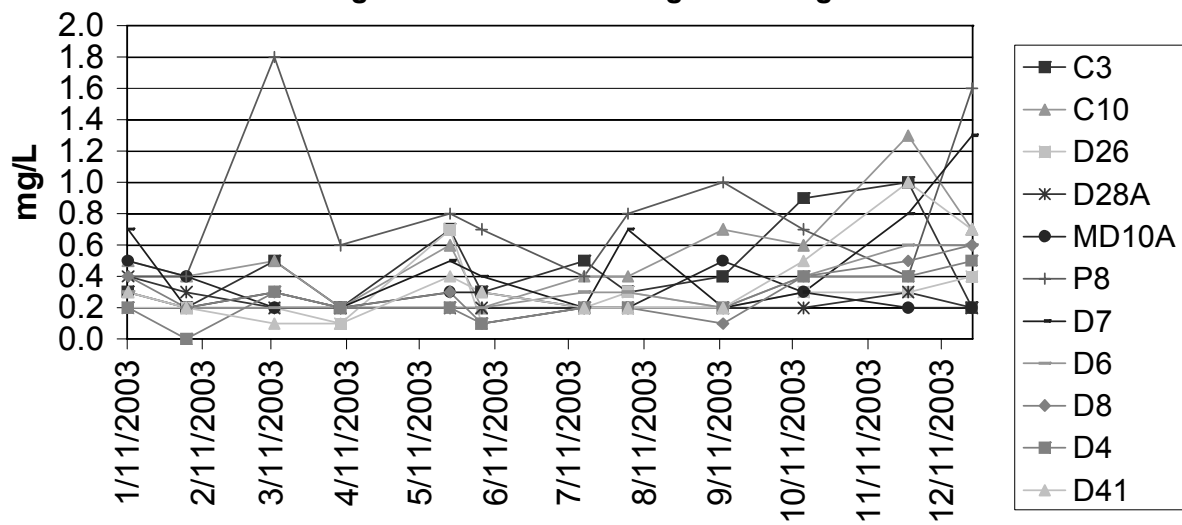


Figure 3-21 Dissolved organic nitrogen (mg/L), 2003

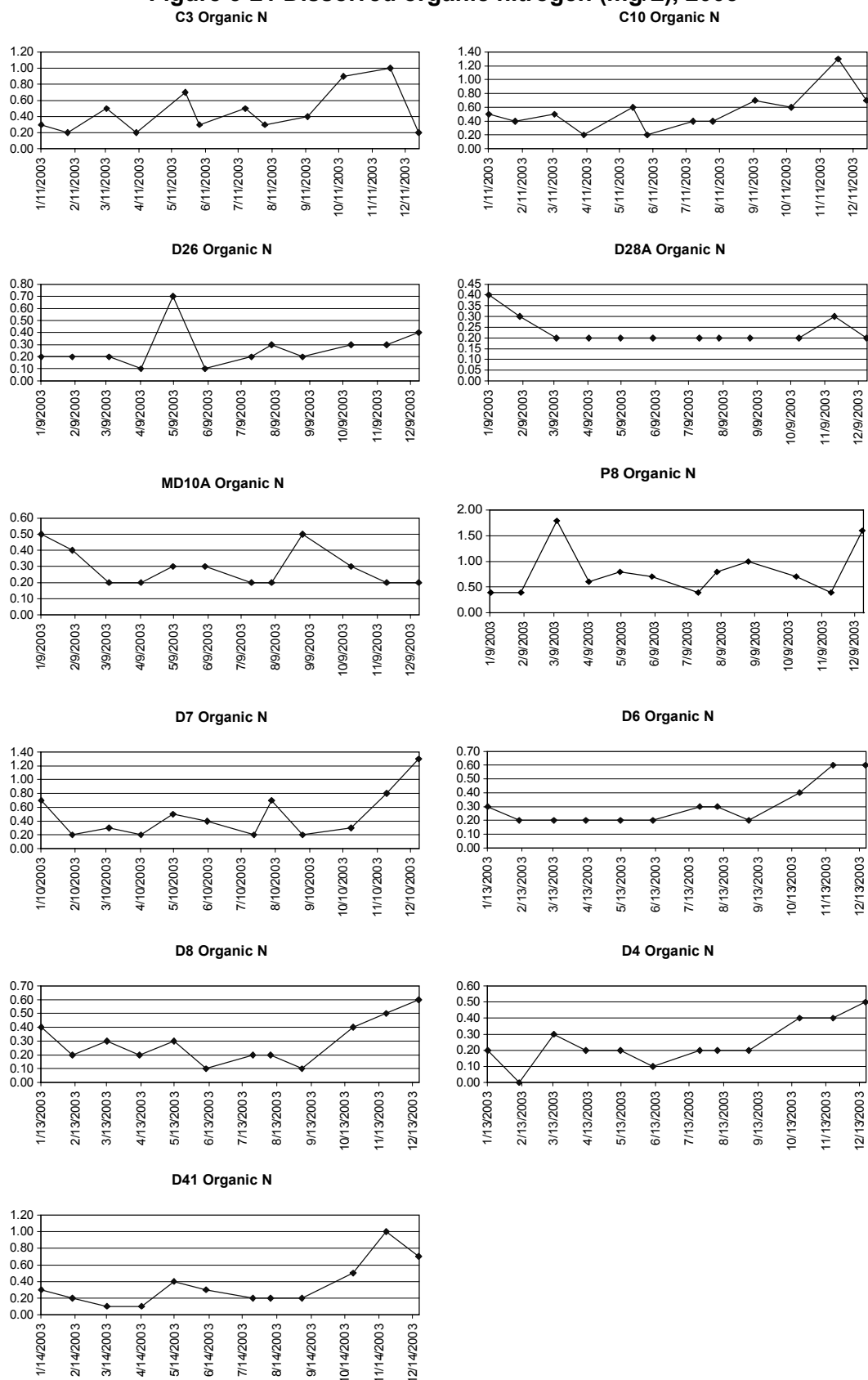


Figure 3-22 Total dissolved solids

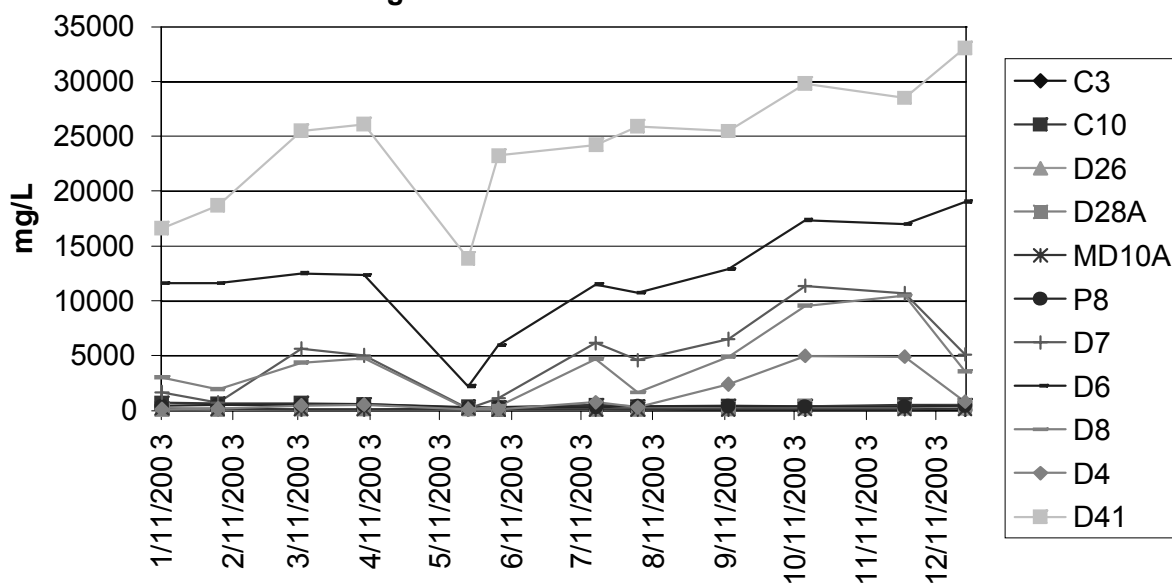


Figure 3-23 Total dissolved solids (mg/L), 2003

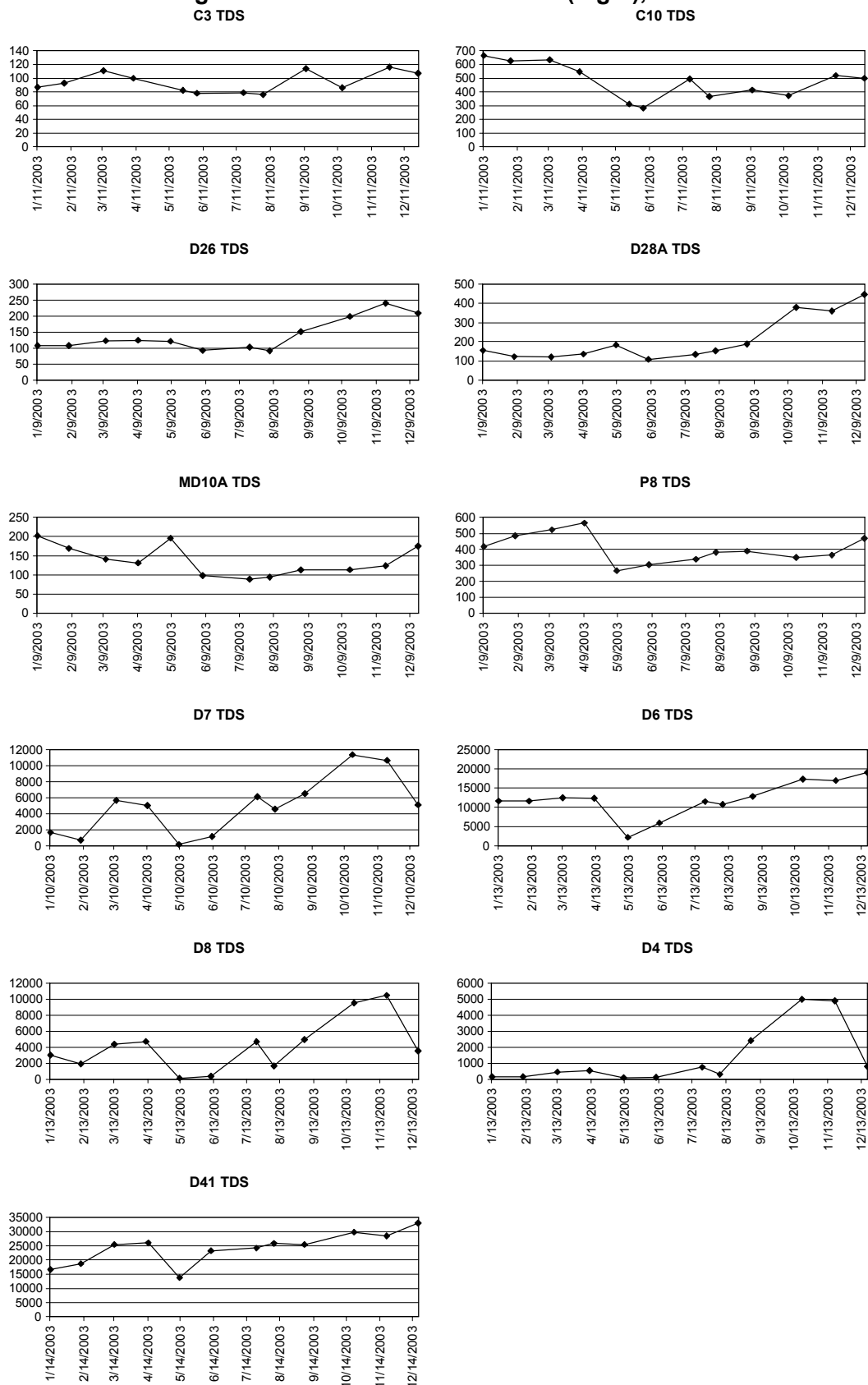


Figure 3-24 Total suspended solids

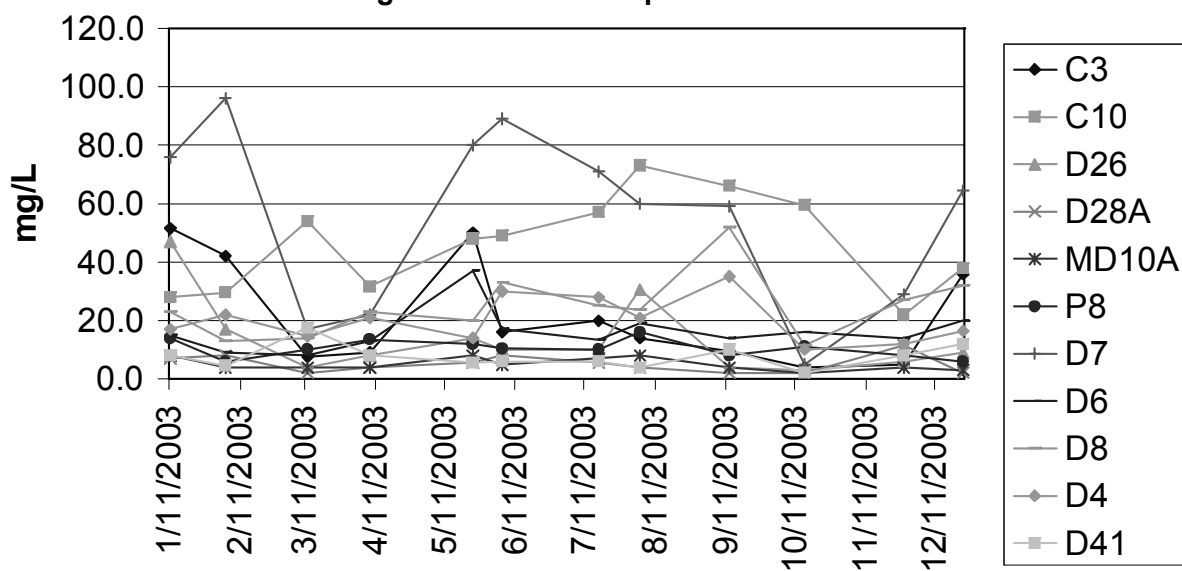


Figure 3-25 Total suspended solids (mg/L), 2003

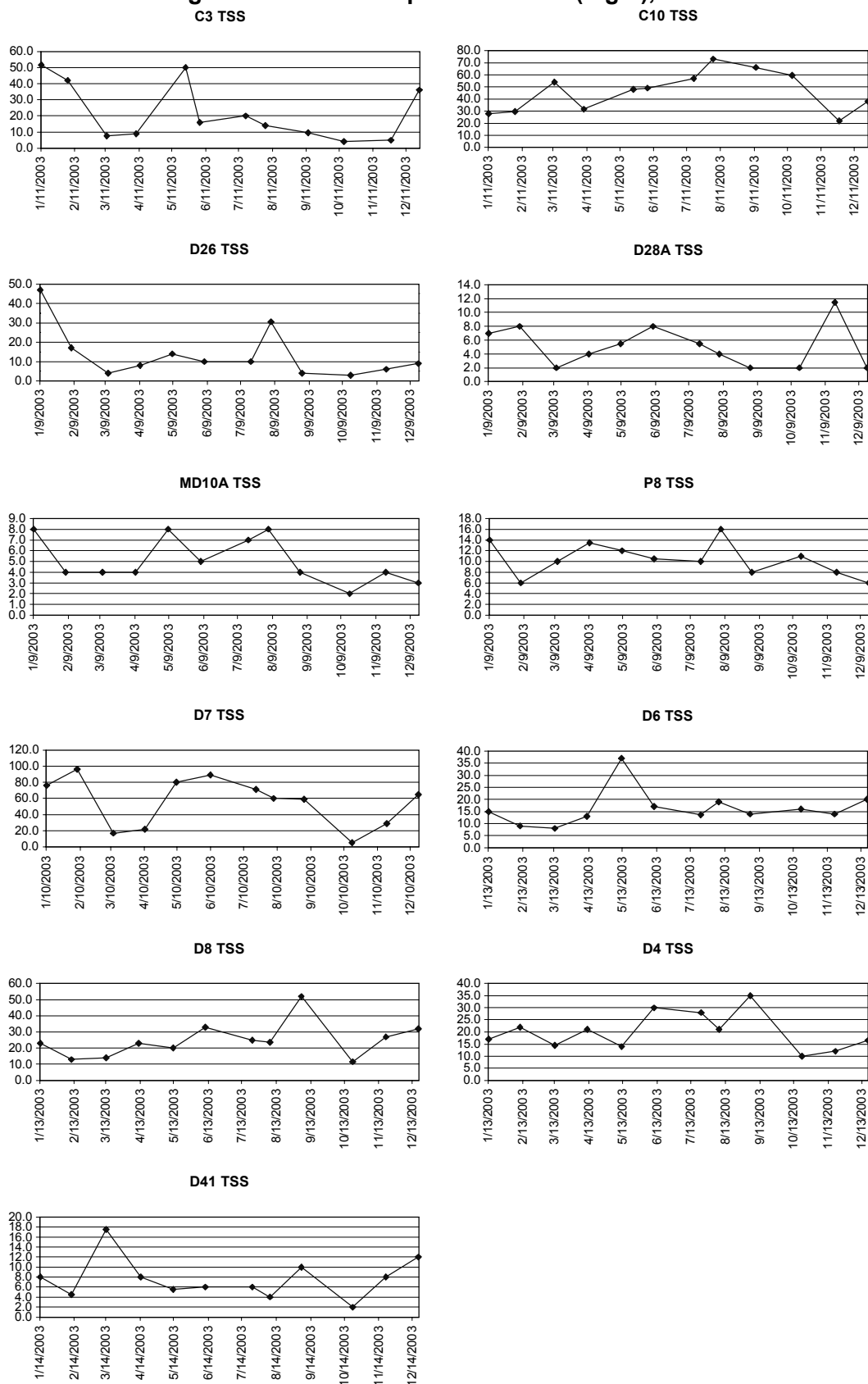


Figure 3-26 Volatile suspended solids

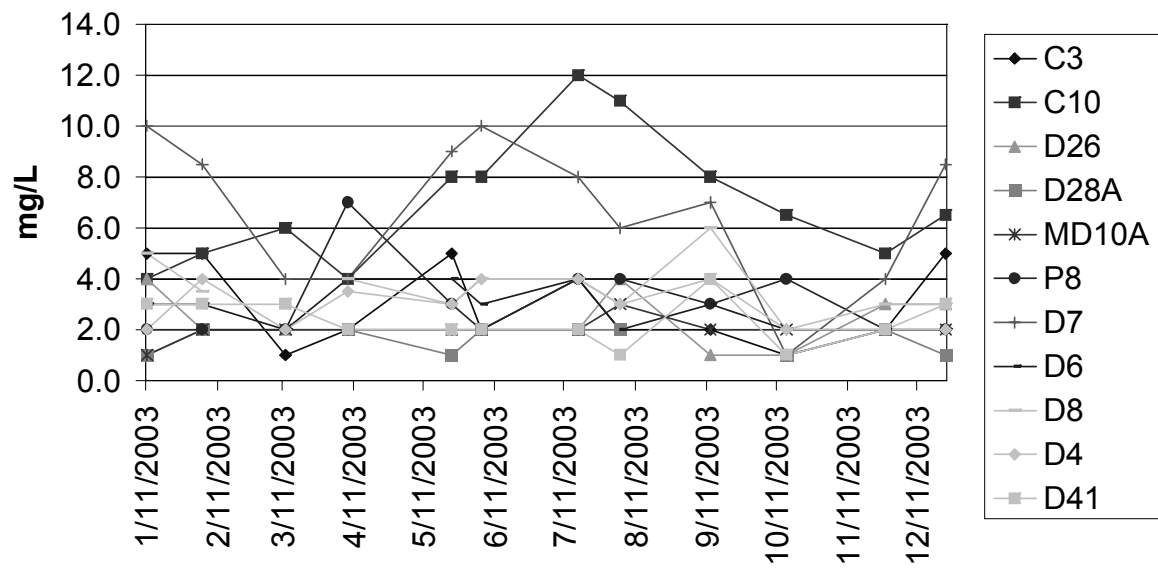


Figure 3-27 Volatile suspended solids (mg/L), 2003

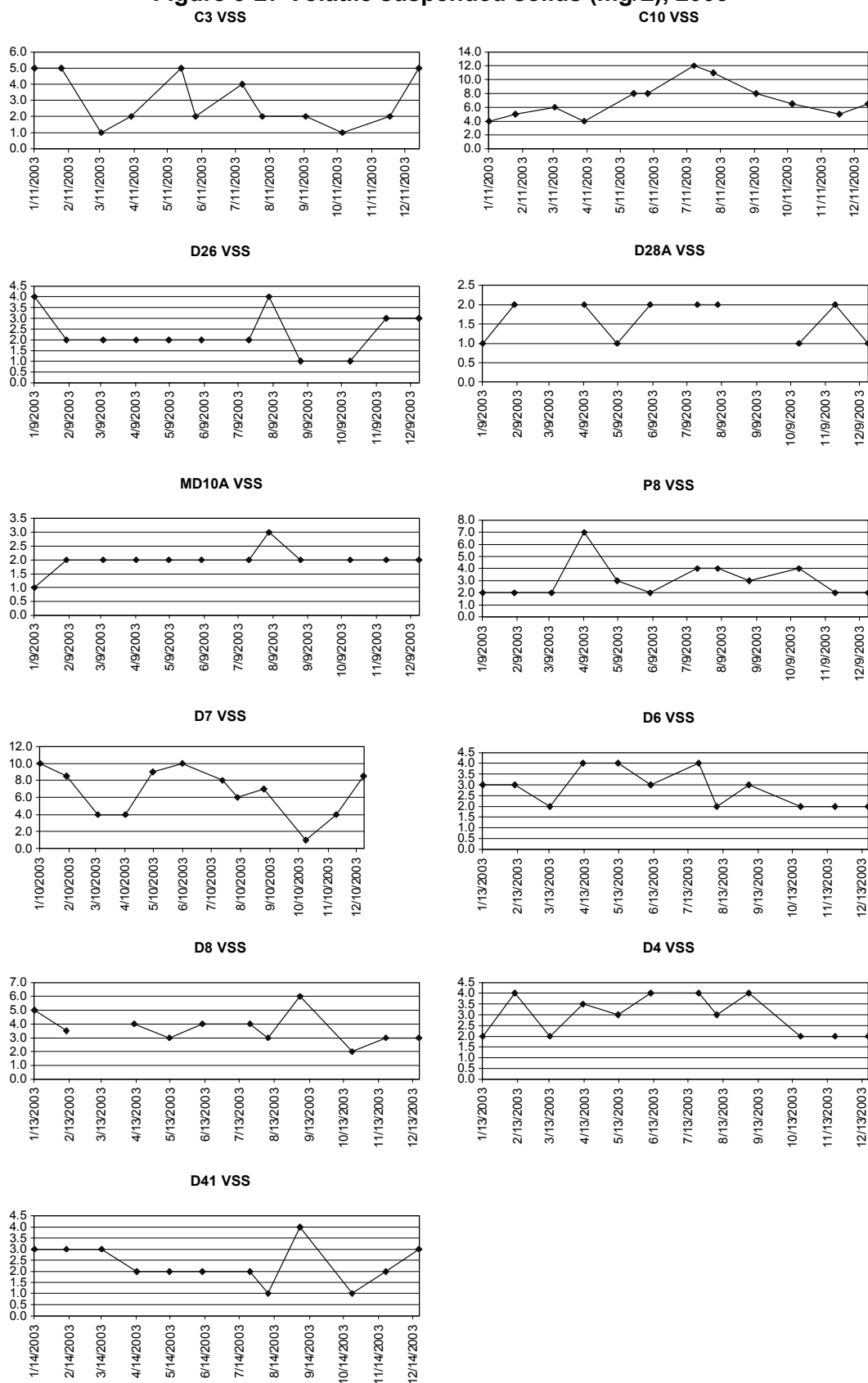


Figure 3-28 Silica

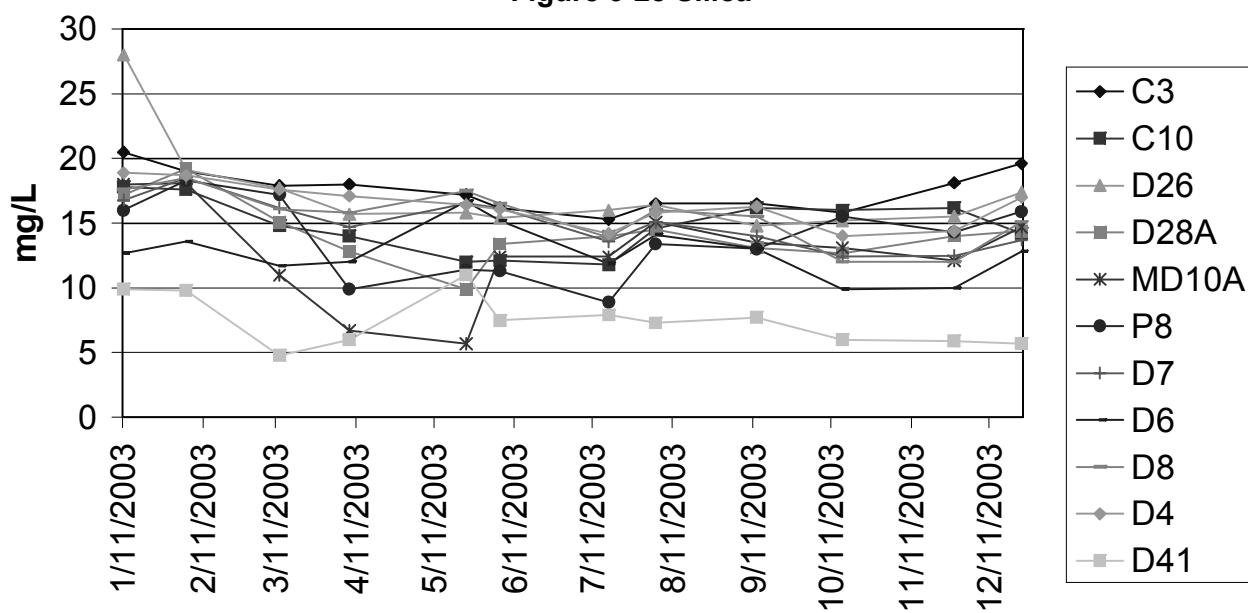
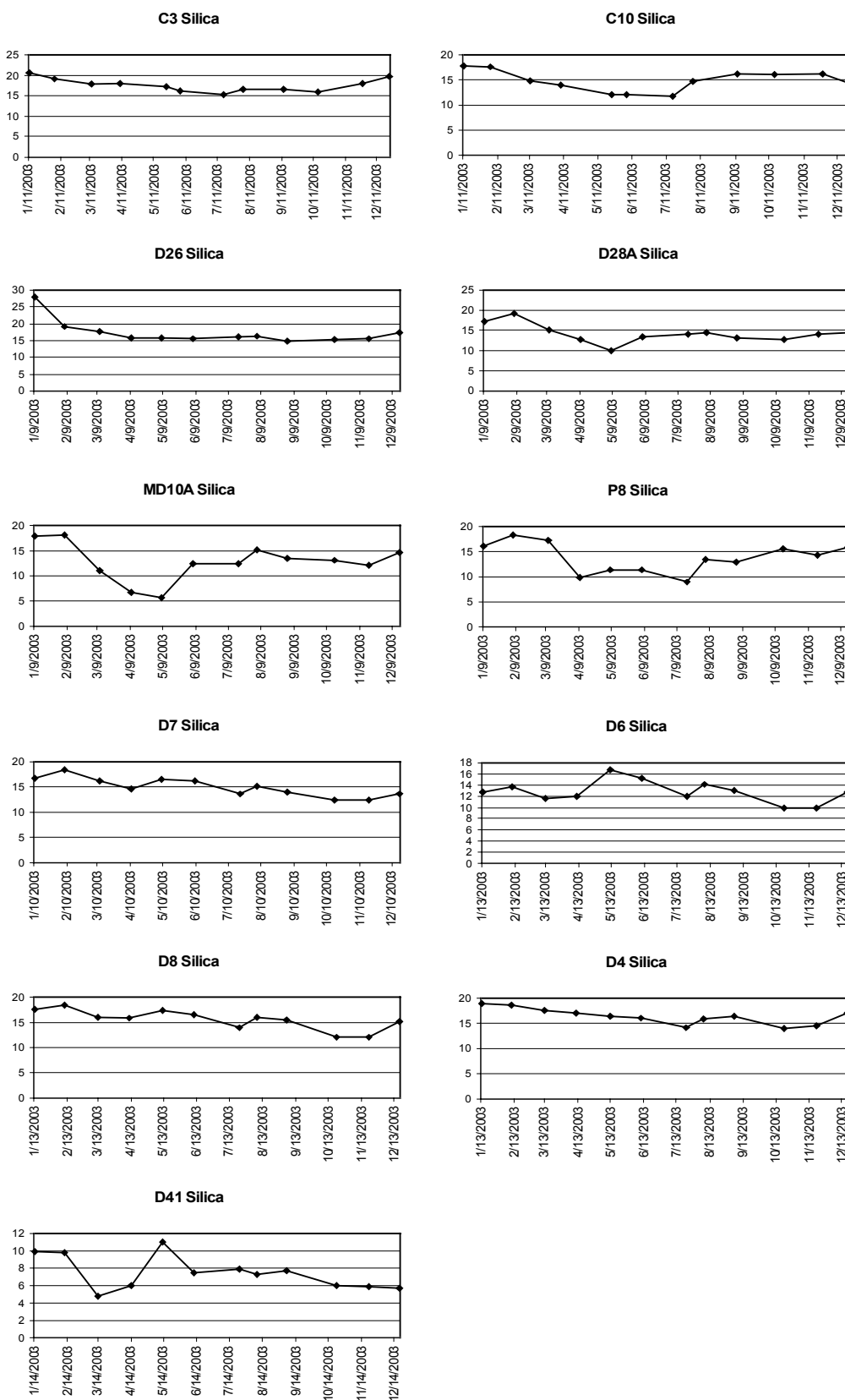


Figure 3-29 Silica (mg/L), 2003



mg/L

1/11/2003 2/11/2003 3/11/2003 4/11/2003 5/11/2003 6/11/2003 7/11/2003 8/11/2003 9/11/2003 10/11/2003 11/11/2003 12/11/2003

Legend:

- C3
- C10
- D26
- D28A
- MD10A
- P8
- D7
- D6
- D8
- D4
- D41

Figure 3-31 Chloride (mg/L), 2003

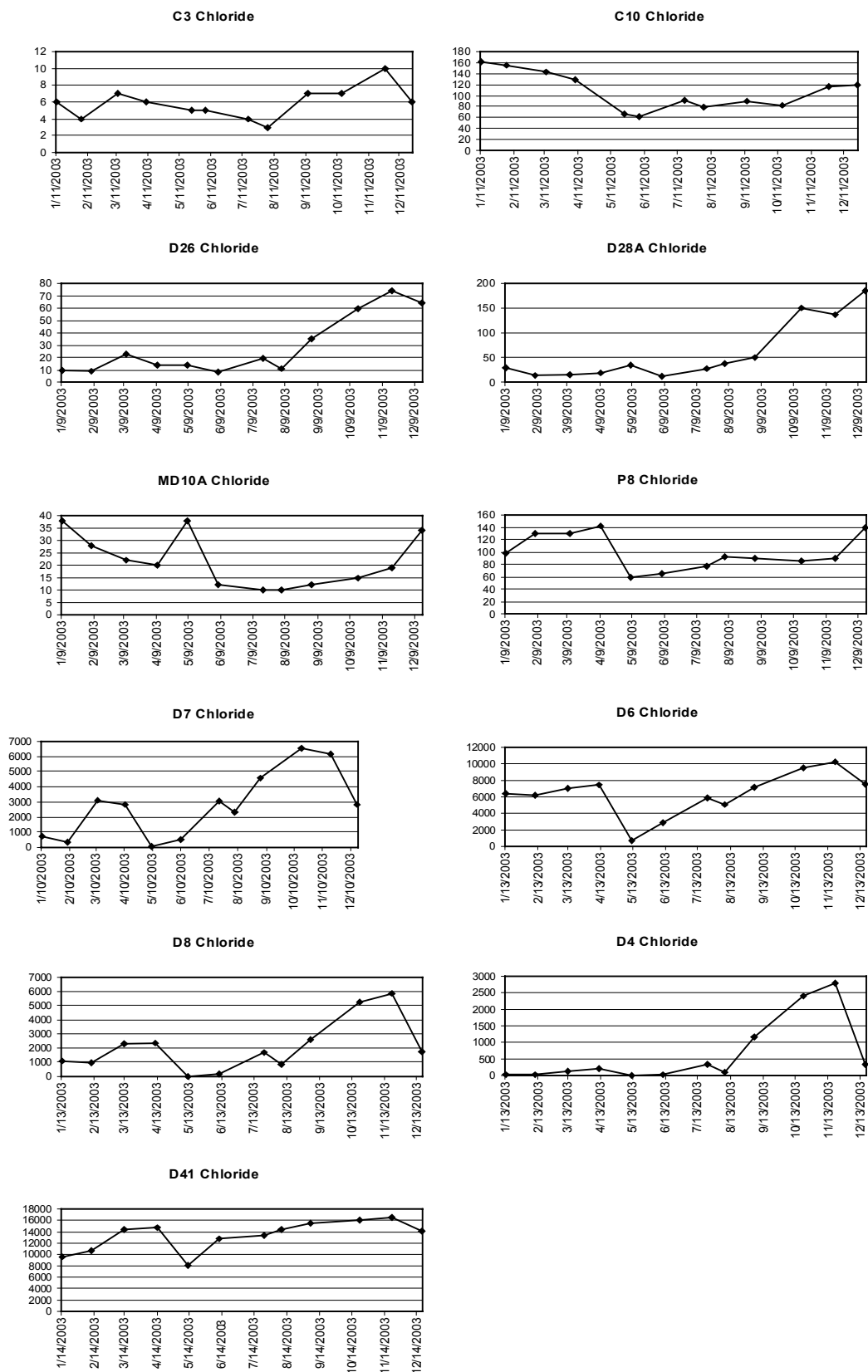


Table 3-1 Water quality parameters measured

Parameter	Units
Water temperature	°C
Dissolved oxygen	mg/L
Specific conductance	µS/cm
Secchi disk depth	cm
Turbidity	NTU
Orthophosphate	mg/L
Total phosphorus	mg/L
Kjeldahl nitrogen	mg/L
Dissolved inorganic nitrogen	mg/L
Dissolved organic nitrogen	mg/L
Total dissolved solids	mg/L
Total suspended solids	mg/L
Volatile suspended solids	mg/L
Silica	mg/L
Chloride	mg/L

Table 3-2 Water quality sampling sites and regions

Region	Sampling Sites
Lower Sacramento River	D4
Lower San Joaquin River	D26
North Delta	C3
Central Delta	D28A
East Delta	MD10
South Delta	C10 and P8
Suisun Bay	D6, D7 and D8
San Pablo Bay	D41